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EFFECT OF PRE-HARVEST SPRAY OF CHEMICALS TO CHECK DECAY LOSS OF AONLA FRUITS DURING STORAGE AT AMBIENT TEMPERATURE

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ABSTRACT

Pre-harvest spray of agro-chemicals viz. calcium nitrate @1.0 %, Topsin-M or Thiophanate methyl @ 0.1% and Bayleton or Triademefon @ 0.1% either alone or in combination were applied twice i.e. 20 days and 10 days before harvest at an interval of 10 days with 3 objectives (i) to study shelf life of Aonla fruits (ii) to maintain fruit quality parameters (TSS, acidity and vitamin C content) and (iii) to check fungi or pathogens responsible for decay loss at ambient temperature during storage. Results reveal that pre-harvest spray of test agro-chemicals reduced physiological loss in weight (PLW) and decay loss up to 15 days of storage over control. Fruit quality parameters viz. TSS, acidity and vitamin C were maintained up to 15 days of storage. Extent of fungal attack was reduced with twice spray of test fungicides viz. Topsin-M and Bayleton up to 15 days of fruit storage in CFB boxes except initial rotting due to blue mould fungus (*Penicillium oxalicum*) in calcium nitrate alone spray. The un-sprayed fruits attacked by *P. oxalicum* more rapidly which caused soft rot and also by *Alternaria alternata* responsible for dry rot. Among treatments, calcium nitrate (1.0%) + Topsin M (0.1%) was the best treatment followed by calcium nitrate (1.0%) + Bayleton (0/1%) to reduce decay loss and to extend the shelf life of Aonla fruits.

Keywords : *50C, stock, soyabeen, wheat cropping, fertilization.*

INTRODUCTION

Aonla (*Emblica officinalis* Gaertn.) or (*Phyllanthns enblicae* L.) belonging to family Euphorbiaceae is commercially cultivated in Uttar Pradesh particularly in the area of saline- alkali soils. Now a day, its cultivation is gaining much popularity due to diverse importance and uses. The major products of Aonla fruits are Candy, Chyavanprash, Triphla, Jam, Pickle, Shred, Toffee, Barfee, Laddoo as well as dye and hair oil etc. It is also a good source of vitamin c and useful for drink preparations in the form of ready to serve (RTS). On the other hand, a number of fungi attacked on Aonla fruits specially during the later stages of growth and development and some of them damaged the fruits during storage and ultimately rendering large portion of such frits unfit for human consumption There are few information available on the keeping quality of

Aonla fruits (Singh 1984, Ojha, 1987 and Pathak, 1988) but no work was carried out on pre-harvest spray of calcium nitrate and/or fungicides to check decay losses during storage. However, the present investigation supports a study on pre-harvest spray of calcium nitrate either alone or in combination with Topsin-M and Bayleton on fruit bearing plants of Aonla cv. Narendra Aonla-7 to cheek physiological weight loss and decay loss of fruits as well as maintain fruit quality at ambient temperature during storage.

MATERIALS AND METHODS

Pre-harvest spray of agro-chemicals was carried out on twelve years old Aonla plants cv. Narendra Aonla-7 in the Main Experiment Station, Horticulture, N.D University of Agriculture and Technology, Kumarganj, Faizabad, Uttar Pradesh, India during 1999-2000 fruiting season with 3 objectives (i) to extend storage life of fruits (ii) maintain fruit quality parameters such as TSS, acidity and vitamin C and (iii) identification of major fungi responsible for decay loss. The spray of calcium nitrate@ 1.0%, Topsin-M or Thiophanate methyl @0.1% and Bayleton or Triademefon @0.1% alone or in combination applied twice as first spray before 20 days of fruit harvest dated 25 November ,1999 and second spray before 10 days of fruit harvest dated 05 December,1999 on fruit bearing Aonla plants cv. NA-7. The fruits were harvested or picked up on 15 December, 1999 with full maturity at the best physiological age and size. Regarding this study, three kilogram randomly selected Aonla fruits of each treatment kept in CFB boxes of 45x30x30 cm size with newspaper rolls as packing material and stored at room temperature during 15December, 1999 to 10 January, 2000 a period of 25 days. All the six treatments were replicated three times keeping in view, the separate box as one replication. These fruits were critically examined at a regular interval of 5 days for recording of physiological weight loss (%), decay loss (%), quality parameters viz. Total Soluble Solids (Brix°), acidity (%) and vitamin C (mg/100g pulp) as well as occurance of fungal pathogens responsible for decay. The identification of pathogens/fungi was scheduled with the help of standard phyto-pathological diagnostic methods under compound microscope.

RESULTS AND DISCUSSION

Pre-harvest treatment of fruits is an appropriate strategy in situations where considerable injury almost anticipated. The present investigation reveals a good result of pre-harvest sprays of calcium nitrate @1.0%, Topsin-M@ 0.1% and Bayleton@ 0.1% either alone or in combination as they reduced post-harvest losses of Aonla fruits during storage at room temperature between 15 December, 1999 and 10 January,2000 a period of 25 days.

Regarding physiological weight loss of Aonla fruits, twice sprays of test systemic fungicides namely Topsin-M and Bayleton in combination with calcium nitrate or alone provided a better protection against losses during storage. The results of Table1 reveal that less than 5% physiological loss in weight (PLW) was recorded in all treatments except spray of calcium nitrate alone (5.12% PLW) over control (10.42% PLW) during initial 10 days of storage. As well, less than 10.00% PLW was found in fruits having sprays with calcium nitrate+ Topsin-M (6.77% PLW), Topsin-M alone (6.95% PLW), calcium nitrate + Bayleton (9.23% PLW) and Bayleton alone (9.76% PLW).Khitron and Lyublinskaya (1991) reported that 'Muscate of Hamberg' and 'Italia' grapes were best stored up to 30 days after pre-harvest spray of 1.2% calcium chloride+0.25% Bayleton or 1.2% calcium chloride+0.13% Topsin-M.

Pre –harvest sprays of test agro-chemicals is well recognized to manage decay loss and extend

storage life of Aonla fruits. The results of Table 2 showed that no decay loss was observed in Aonla fruits during initial 10 days of storage at room temperature. Less than 10% decay loss was recorded in all the treatments for 15 days of storage. Overall minimum decay loss 8.09% was recorded in Aonla fruits having sprays with calcium nitrate+ Topsin-M followed by 8.35% decay loss in Topsin-M alone, 9.41% decay loss in calcium nitrate+ Bayleton over control during 25 days of storage whereas Singh(1984) stored Aonla fruits in his study for 15 days at room temperature without decay loss. In the present findings, calcium nitrate alone was found least effective to manage decay loss of Aonla fruits but provided better response in combination with test fungicides. Gupta *et al* (1981) and Singh *et at*. (1983) reported a good management of decay loss with pre-harvest spry of calcium on grape and ber fruits, respectively.

The effectiveness of pre-harvest spray of test chemicals was also evaluated for fruit quality parameters of Aonla cv. NA-7.The results of Table 3 reveal a gradual increase in Total Soluble Solids (TSS) and decrease in acidity and vitamin C in all the treatments. The highest value of TSS 14.22%, acidity 2.04% and vitamin C 541.06mg/100g pulp were recorded in the fruits having pre-harvest sprays of calcium nitrate+ Topsin-M followed by TSS 13.78%, acidity 1.98% and vitamin C 531.33mg/100g pulp in the fruits having treatment of calcium nitrate+ Bayleton as well as TSS 13.43%, acidity 1.91 % and vitamin C 519.94mg/100g pulp in the fruits having treatment of calcium nitrate alone. It is also evident from these results that twice spray of calcium nitrate maintained keeping quality of Aonla fruits during storage. Similar trend has also reported by Singh et.al.(1983 in Ber fruits as well as Singh and Chauhan (1982) and Singh (1985) in Guava fruits.

Pre-harvest spray of agro-chemicals always protected fruits against fungal infections during storage at ambient temperature. The study reveals that no infection of fungus was observed on the fruits during initial 5 days of storage at room

Table - 1 : Effect of pre-harvest spray of chemicals on physiological weight loss of Aonla fruits cv. NA-7 during storage at ambient temperature.

S.No.	Treatment	Storage period (days)					
		5	10	15	20	25	Mean
T1	Calcium nitrate (1.0%)	2.45	5.12	10.30	17.86	20.18	11.18
T2	Topsin-M (0.1%)	1.71	4.33	6.95	13.50	18.90	9.07
T3	Bayleton(0.1%)	2.13	4.41	7.83	15.12	19.31	9.76
T4	Calcium nitrate+Topsin-M	1.33	3.40	6.77	12.47	17.85	8.38
T5	Calcium nitrate+Bayleton	1.73	4.35	7.36	13.75	19.00	9.23
T6	Control	4.66	10.42	14.01	21.55	27.42	15.61
	Mean	2.34	5.33	8.87	15.72	20.44	10.53
CD(0.05)	Treatment=0.84	Storage period=0.77	Interaction (Treatment* storage period)=1.89				

temperature. This observation also indicated that these fruits were free from infection. After 10 days of storage, presence of *Penicillium oxalicum* was observed on fruits having twice pre-harvest sprays of calcium nitrate whereas *Alternaria alternata* and P. oxalicum exhibited on fruits of no spray or control

Table - 2 : Effect of pre-harvest spray of chemicals on decay loss of Aonla fruits cv. NA-7 during storage at ambient temperature.

S.No.	Treatment	Storage period(days)					
		5	10	15	20	25	Mean
T1	Calcium nitrate (1,0%)	0	3.60 (10.92)	9.85 (18.29)	26.64 (31.05)	41.69 (40.21)	16.36 (20.09)
T2	Topsin-M (0.1%)	0	0	5.40 (13.42)	14.31 (22.22)	22.06 (27.99)	8.35 (12.72)
T3	Bayleton(0.1%)	0	0	7.36 (15.73)	15.79 (23.18)	27.89 (31.85)	10.20 (14.19)
T4	Calcium nitrate+TopsinM	0	0	5.22 (13.20)	13.52 (21.57)	21.71 (27.75)	8.09 (12.50)
T5	Calcium nitrate+Bayleton	0	0	5.49 (13.53)	14.25 (22.17)	27.32 (31.50)	9.41 (13.40)
T6	Control	0	6.23 (14.13)	11.23 (19.57)	31.14 (33.91)	46.72 (43.12)	19.06 (22.21)
Mean		0	1.63 (4.23)	7.42 (15.62)	19.27 (25.35)	31.23 (33.74)	11.91 (15.82)
CD(P= 0.05)	Treatment=0.55	Storage period=0.55	Interaction (Treatment*Storage period)=1.23				

Table - 3 : Effect of pre-harvest spray of chemicals on total soluble solids (TSS) of Aonla fruits cv. NA-7 during storage at ambient temperature.

Table - 3.1 : Determination of TSS in Aonla fruits cv. NA-7

S.No.	Treatment	Storage period(days)						
		0	5	10	15	20	25	Mean
T1	Calcium nitrate (1.0%)	13.00	13.25	13.33	13.50	13.75	14.00	13.47
T2	Topsin-M (0.01%)	12.50	13.00	13.00	13.00	13.50	14.00	13.16
T3	Bayleton(0.01%)	12.75	13.00	13.00	13.00	13.25	13.75	13.12
T4	Calcium nitrate+ Topsin-M	14.00	14.00	14.25	14.25	14.33	14.50	14.22
T5	Calcium nitrate+Bayleton	13.00	13.25	13.67	14.00	14.25	14.50	13.78
T6	Control	12.00	12.50	12.50	12.50	13.00	13.50	12.67
	Mean	12.87	13.16	13.29	13.37	13.68	14.04	13.40
CD(P =0.05)	Treatment=0.29	Storage period=0.29	Interaction(Treatment*Storage period=0.73)					

Table - 3.2 : Determination of acidity in Aonla fruits cv. NA-7

S.No.	Treatment	Storage period(days)						
		0	5	10	15	20	25	Mean
T1	Calcium nitrate(1.0%)	1.55	1.61	1.88	1.98	2.01	2.08	1.85
T2	Topsin-M(0.01)	1.52	1.53	1.82	1.92	1.92	2.01	1.78
T3	Bayleton(0.01%)	1.51	1.53	1.60	1.74	1.74	1.77	1.65
T4	Calcium nitrate+ Topsin-M	1.75	1.79	2.01	2.11	2.11	2.18	1.99
T5	Calcium nitrate+Bayleton	1.67	1.69	1.95	2.04	2.11	2.14	1.93
T6	Control	1.40	1.50	1.53	1.54	1.56	1..66	1.53
Mean		1.56	1.60	1.79	1.08	1.90	1.0=97	1.78
CD(0.05)	Treatment=0.07	Storage period=0.07	Interaction (Treatment*storage period=0.18					

Table - 3.3 : Determination of vitamin C in Aonla fruits cv.NA-7 during storage at ambient temperature

S. No.	Treatment	Storage period(days)						
		0	5	10	15	20	25	Mean
T1	Calcium nitrate(1.0%)	660.00	560.00	548.00	537.00	428.55	386.10	519.94
T2	Topsin M (0.01%)	616.00	610.90	563.05	515.20	384.65	254.10	490.65
T3	Bayleton(0.01%)	618.18	544.00	507.20	470.40	420.25	320.10	480.02
T4	Calcium nitrate+TopsinM	694.54	680.00	599.20	518.40	424.20	330.00	541.06
T5	Calcium nitrate+Bayleton	640.00	630.00	603.46	576.00	438.15	300.30	531.32
T6	Control	600.00	525.00	455.00	422.00	333.00	244.20	429.83
Mean		638.12	591.65	545.98	506.50	404.80	305.80	498.81
CD(0.05)	Treatment=8.13	Storage period=8.13	Interaction(Treatment* storage period)=19.91					

treatment. It means pre-harvest spray of test fungicides viz. Topsin-M and Bayleton protected decay loss of Aonla fruits due to *P. oxalicum* and *A. alternata* during 10 days of storage at room

temperature. After 15 days of storage, presence of *P. oxalicum* was occurred on fruits in all treatments while other pathogens such as *A. alternata* on fruits having pre-harvest spray of calcium nitrate as well as *A. alternata* and *Aspergillus niger* with or without *P. oxalicum* recorded on fruit of no spray or control treatment. These results also suggested that *P. oxalicum* responsible for soft rot was most destructive fungus which affected storage life and caused huge losses of Aonla fruits. After 20 days of storage, only P. oxalicum and A. alternata were recorded on the fruits having pre-harvest sprays of Topsin-M and Bayleton in combination with calcium nitrate or alone. Other fungi such as Aspergillus flavus,A.niger and Fusarium sp.including former two fungi were also responsible

Table - 4 : Effect of pre-harvest spray of chemicals on occurance of pathogens /fungi on Aonla fruits cv. NA-7 during storage at ambient temperature

S.No.	Treatment	Storage period (days)				
		5	10	15	20	25
T1	Calcium nitrate (1.0%)	-	Penicillium oxalic*u*m	Penicillium oxalicum Alternaria alternata	Penicillium oxalicum Alternaria alternata Aspergillus niger Fusarium sp	Penicillium oxalicum Alternaria alternata Aspergillus niger Fusarium sp.
T2	Topsin M(0.01%)	-	-	Penicillium oxalicum.	Penicillium oxalicum Alternaria alternata	Penicillium oxalicum Alternaria alternata
T3	Bayleton(0.01%)	-	-	Penicillium oxalicum.	Penicillium oxalicum. Alternaria alternata	Penicillium oxalicum Alternaria alternata
T4	Caalcium nitrate+Topsin M	-	-	Penicillium oxalicum.	Penicillium oxalicum Alternaria alternata	Penicillium oxalicum Alternaria alternata
T5	Calcium nitrate+Bayleton	-	-	Penicillium oxalicum.	Penicillium oxalicum Alternaria alternata	Penicillium oxalicum Alternaria alternata
T6	Control	-	Penicillium oxalicum. Alternaria. alternata	Penicillium oxalicum Alternaria alternata Aspergillus niger	Penicillium oxalicum Alternaria alternata Aspergillus niger Fusarium sp.	Penicillium oxalicum Alternaria alternata Aspergillus niger Fusarium sp.

for decay loss of Aonla fruits which making such fruits unfit to human consumption.

It is evident from present findings that twice pre-harvest spray of test systemic fungicides viz. Topsin-M and Bayleton@ 0.1% with calcium nitrate or alone provided better performance of Aonla fruits up to 10 days of storage at ambient temperature. These fruits, if stored for 15 days, exhibited slight infection of P. oxalicum. It means the Aonla fruits cv.NA-7 can be stored best up to 10 days of storage without economic loss and useful for better human consumption. Among treatments, calcium nitrate@ 1.0%+ Topsin-M@ 0.1% twice spray on Aonla fruits appears as best treatment which minimized physiological loss in weight and decay loss, also maintained keeping quality of fruits as well as reduced occurance of fungi on stored fruits followed by calcium nitrate@ 1.0%+Bayleton @0.1%.

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EVALUATION OF GROWTH AND YIELD OF DIFFERENT MUSTARD (*BRASSICA JUNCEA*L.) HYBRIDS UNDER AGRO-CLIMATIC CONDITION OF PRAYAGRAJ

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ABSTRACT

A field experiment was conducted during *rabi* season of 2017-18 at Crop Research Farm, Department of Agronomy, SHUATS, Allahabad, (U.P.) To study the effect of different hybrids on growth and yield of mustard. The experiment consisted 5 treatments *i.e.* $T_{1:}$ Pioneer-45546, T_2: Dayal Seed Umang DPH-21,T_3: Bayer IJI3R1110, $T_{4:}$ Pioneer-45542,T_5: Bayer Kesari Gold.The present experiment was laid out in Randomized Block Design which replicated four times,. The results revealed that treatment T_5 Bayer Kesari Gold recorded maximum plant height at 80 DAS, whereas, maximum dry weight at 80 DAS (37.81) and yield component *i.e.* Number of Siliqua/ plant(920.85), Number of seeds/ siliqua (14.97), Test weight (g) (6.02) and Seed size (2.30 mm) and seed Yield (26.66 q/ha), stover yield (74.49 q/ha) and harvest index (27.63 %) was recorded in T_3 Bayer IJI3R1110DAS. Yield.

Keywords : *Mustard, varieties, growth, yield attributes , yield and harvest index.*

INTRODUCTION

Indian mustard (*Brassica juncea* L.) is one of the most important winter oilseed crops and India is the third largest rapeseed-mustard producer in the world after China and Canada with 11.12% of world's total production (DRMR, 2012-13). Rapeseed- Mustard is the second most important oilseed crop in India after soybean and accounts for nearly 20-22% of total oilseeds produced in the country. Mustard seed is grown with a different consumption pattern in the country. Indian mustard is mainly used for extraction of mustard oil while black mustard is mainly used as a spice (Anonymus, 2015). Improved varieties plays a crucial role in raising the seed yield of the crop. Development of HYV's of mustard has been one of the major concern of the scientists because use of the improved varieties alone accounts for 15-20% increase in productivity. This is probably because of their altered morphology which results into efficient utilization of water, nutrients and radiation. Keeping these point in view, the present investigation of

Mustard was carried out.

MATERIALS AND METHODS

The experiment was carried out during *Rabi* season of 2017 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (U.P.) which is located at 25^0 24' 42" N latitude, 81^0 50' 56" E longitude and 98 m altitude above the mean sea level. This area is situated on the right side of the river Yamuna by the side of Allahabad Rewa Road about 5 km away from Prayagraj city. The soil of experimental field was sandy loam having a pH of 7.6, with 0.15 (%) organic carbon, available nitrogen (35.55 kg/ha), available phosphorus (9.8 kg/ha) and available potassium (187.2 kg/ha). The experiment consisted of five treatment T_1 Pioneer-45546, T_2 Dayal Seed Umang DPH-21, T_3 Bayer IJI3R1110 T_4 Pioneer-45542, T_5 Bayer Kesari Gold. The experiment was conducted under Randomized block design with four replication. The experimental crop was fertilized with NPKSZN Kg/ha (60: 60:40:30:25). Half dose of nitrogen and full dose of phosphorus, potassium, sulphur and zinc was applied as basal dose and remaining half dose of nitrogen was applied as top dressing. During the crop season, light irrigations were given and inter-culture operations were done to remove the weeds.

Observation regarding growth like Plant height (cm), dry matter accumulation were recorded at 20,40,60,80 DAS. Plant height was recorded by selecting 5 random plants from each net plot and tagged and height of plants was measured with the help of meter scale from soil surface to apex of the plant and mean value from all recorded data was worked out. Five plants were randomly uprooted without damaging the root from each plot at 20, 40, 60, 80 DAS. The samples were air dried and then kept in oven for 72 hours at 70^0 C, their dry weight was determined without root and the average dry weight/ plant was calculated. Number of siliqua on the main shoot as well as on whole plant of each of the five randomly selected plants in each treatment was counted separately at maturity and computed as mean number of siliquae per main shoot and per plant. Twenty-five siliqua were randomly collected in each treatment at harvest and total number of seeds/ siliqua in them was counted. From this, mean number of seeds per siliqua was calculated. After threshing the crop, a representative sample of seeds was obtained from bulk produce of the whole plot. One thousand seeds were counted and weighed to give 1000- seed weight. Seeds obtained after threshing of dried produce per net plot was cleaned, dried and weighed to give seed yield per plot. Seed yield was computed as q/ha. Stover yield of each plot was calculated by subtracting seed yield from biomass yield of each plot and then converted into q/ha. Harvest index (H.I) represents the proportion of seed yield in comparison to total biomass yield.

RESULTS AND DISCUSSION

Growth and Yield Attributes influenced by different mustard hybrids

Table no. 1 revealed that Plant height (cm) of hybrid mustard was increased with increasing the age of crop. It has been observed that plant height of hybrid was significantly differ with each other. At 80 DAS maximum (207.65 cm) plant height was recorded in hybrids Pioneer-45546 which was found to be statistically at par with hybrid Bayer IJI3R1110. It might be due to better light interception and accumulation of more photosynthates, thus produced higher dry matter.

Similar finding was observed by Dongarkar *et al*. (2005) and Singh *et al* (2010) . It was observed in Table 1 that there was significant difference due to varietal variation. The Dry matter accumulation progressively increased with crop age. Maximum dry matter was recorded in hybrid Bayer IJI3R1110 (37.81) which was statistically at par with hybrid Pioneer- 45542 at 80 days after sowing. Accumulation of dry matter in the plant is directly related to plant height, which were appreciably similar condition as. similar finding given by Patel *et al* (2017).

Table 2 showed that Among the yield contributing character viz. number of seeds/siliqua had no significant variation among all the varieties, although maximum was recorded in Bayer Kesari Gold (15.35). Whereas, maximum number of siliqua/plant was recorded in hybrid Bayer IJI3R1110 (920.85). It might be due to similar seed filling pattern in economically productive part of plant. Similar finding was observed by Piri *et al*. (2014).

Test weight of mustard hybrid Bayer IJI3R1110 (6.02 g) gave maximum test weight which was found to be statistically at par with hybrid Bayer Kesari Gold. Test weight of mustard had significantly affected on by hybrid mustard,which might be due to their own bolder seeds in Bayer IJI3R1110 hybrid as compared to other hybrid of mustard. Similar finding was observed by Singh *et al.* (2002). Seed size of mustard hybrid Bayer IJI3R1110 was recorded maximum (2.3mm), which was significantly higher among all the varieties except hybrid Bayer Kesari Gold (2.2 mm).Seed yield of mustard had no significant effect due hybrid cultivars, although maximum was recorded in hybrid Bayer IJI3R1110 (26.66 q/ha), Stover yield and harvest index of mustard had no significant effect due to mustard hybrids, although maximum was recorded in hybrid Bayer IJI3R1110 i.e. 74.49 q/ha and 27.63 respectively table 3. This might be due to the positive relationship have frequently been cited between the seed yield and the number of siliqua and seed weight per siliqua and mainly a function of seed yield which is generally influenced by genetic structure of difeerent genotype Meena *et al.* (2013).

Table - 1 : Effect of varieties on palnt height and dry weight of hybrid mustard.

Treatments	Plant height at 80 DAS	Dry matter/ plant (g) at 80 DAS
Pioneer-45546	207.05	30.13
Dayal Seed Umang DPH-21	190.60	30.93
Bayer IJI3R1110	205.00	37.81
Pioneer-45542	196.55	36.50
Bayer Kesari Gold	207.65	33.42
SEd±	2.70	1.26
CD (P=0.05)	5.58	2.61

Table - 2 : Effect of varieties on Yield attributes of hybrid mustard

Treatments	Number of Siliqua/plant	Number of seed/ siliqua	Test weight (g)	Seed size (mm)
Pioneer-45546	348.90	14.35	5.66	2.00
Dayal Seed Umang DPH-21	286.35	12.45	5.63	2.00
Bayer IJI3R1110	920.85	14.97	6.02	2.30
Pioneer-45542	450.95	14.25	5.78	2.10
Bayer Kesari Gold	257.30	15.35	6.00	2.20
SEd±	53.511	0.88	0.09	0.09
CD (P=0.05)	110.44	NS	0.18	0.19

Table - 3 : Effect of varieties on seed yield and biological yield of hybrid mustard.

Treatments	Seed yield (q/ha)	Stover yield (q/ha)	Harvest index (%)
Pioneer-45546	25.22	71.68	25.33
Dayal Seed Umang DPH-21	24.71	69.47	26.25
Bayer IJI3R1110	26.66	74.49	27.63
Pioneer-45542	25.55	67.21	27.13
Bayer Kesari Gold	24.99	67.88	26.93
SEd±	2.190	6.790	0.714
CD (P = 0.05)	NS	NS	NS

CONCLUSION

The study may be concluded that productivity of mustard is influenced by genotypes. Among different varieties Bayer IJI3R1110 found very responsive in producing the maximum value in the form of economic traits like Number of Siliqua/plant, Number of seed / siliqua, Test weight (g) and Seed size (mm) seed and stover yield.

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AN ACCOUNT OF BUTTERFLY DIVERSITY AT COLLEGE OF MATERIAL MANAGEMENT (CMM) JABALPUR

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ABSTRACT

The college of Material Management (CMM) Jabalpur was established in the year 1925 as Indian Army Ordnance Corps School of Instructions. Its name was changed to IOAC Training Centre in 1939 and then to AOC School in 1950. It got its current name in the year 1987. It runs under the aegis of Army Welfare Education Society located at Army HQ New Delhi. The campus is surrounded with lush green surroundings and is home for several species of birds both resident and migratory. In present study species of butterflies belonging to orders families are reported.

Keywords: *- Butterflies, CMM, jabalpur, madhya pradesh.*

INTRODUCTION

Insects are known to be the most leading creatures on the planet. They can be found almost universally from the Antarctica to the tropics. They are known to be found in water, land, air, deserts as well as mountains. Class Insecta constitute about one and a half millions of species all around the world, which represents almost 80% of the total species of Animal Kingdom. About 7,50,00 and 7,90,000 were described by May (1990) while Hammond (1992) projected 9,50,000 described species of insects. This class involves the most varied living module of a woodland ecology and have a boundless part in upholding the steering of nutrient component, soil renewal and fortification, crosspollination of phanerogamic floras as well as natural directive of pests (Ehrlich and Wilson, 1991). The insects are supposed to have first originated on the planet in the Devonian period, some 200 million years ago and since then endured various geological eras including glacial periods and evolved into innumerable forms.

The insect fauna of India is enormous. Recently, 589 families and 51,450 species of insects has been reported by Varshney (1977) from India. Among whole insect fauna, butterflies are believed to be most suitable for various ecological studies, as the taxonomy, topographical dispersal and status of several species is comparatively well-known. The phytophagous insects including several species of butterflies, which are primary herbivores in the food chain are known to act as food bio-indicators of the environmental health. Also, they can be utilized to recognize environmentally significant sites for conservation purposes (Sudheendrakumar et al., 1999). The Butterflies, in environment show different form of habitat exploitation. The nature of flora is a significant issue, which controls the requirement and existence of a species on a specific habitat. They are known to be extremely sensitive to

ecological fluctuations, they are easily affected by even comparatively slight turbulences in the habitat so much that they have been well-thought-out as pointers of ecological quality (Williams and Gaston, 1998) and are also treated as pointers of the healthiness of an ecosystem. The occurrence of butterflies highlights accessibility of larval food-plants in excessive richness. As specified formerly, most of the butterflies have precise habitation necessities, as females generally have a habit of to lay eggs only on selective food-plants found in the area.

Butterflies have always been a subject of charm to manhood and they are measured as one of the best-known species of insects. India is recognised as one of the twelve megadiversity countries of the world with two biodiversity hot spots of a total of 18 such sites identified throughout the globe, the North-East region and Western ghats. In fact, India is very rich not only in terms of species diversity, but also blessed with an enormous variety and variability within species along with the presence of large number of endemic species. India occupies 2% of global space and documents nearly 7.28% of global faunal diversity, including about 45,000 plant and 89,500 animal species (Ghosh, 1990; Alfred et al., 1998). Indian subcontinent is home to 1,504 species of Butterflies. Chandra (2007) reported 174 species of Butterflies from Madhya Pradesh and Chhattisgarh, 66 species of butterflies were recorded from TFRI campus by Tiple (2012). In current study, 37 species are reported belonging to 5 families. The list of species is as follows –

MATERIALS AND METHODS

During the survey of The college of Material Management (CMM) by the first author, altogether 37 butterflies were examined from various localities of the CMM by hand picking and net trap methods. The photographed specimens

S. N.	Species
	Hesperiidae (4)
1	*Caltoris kumara* (Moore)
2	*Hasora chromus* (Cramer)
3	*Telicota colon* (Fabricius)
4	*Spialia galba* (Fabricius)
	Lycaenidae (11)
5	*Abisara echerius* (Stoll)
6	*Castalius rosimon* (Fabricius)
7	*Chilades parrhasius* (Butler)
8	*Chilades laius* (Stoll)
9	*Chilades pulti* Kollar
10	*Lampides boeticus* (Linnaeus)
11	*Prosotas nora* (C. Felder)
12	*Psuedozizeeria maha* (Kollar)
13	Silverline *Spindasis vulcanus* (Fabricius)
14	*Tarucus nara* Kollar
15	*Zizula hylax* (Fabricius)
	Nymphalidae (15)
16	*Cynthia cardui* (Linnaeus)
17	*Danaus chrysippus* (Linnaeus)
18	*Danaus genutia* (Cramer)
19	*Euploea core* (Cramer)
20	*Euthalia aconthea* (Cramer)
21	*Hypolimnas bolina* (Linnaeus)
22	*Junonia atlites* (Linnaeus)
23	*Junonia hierta* (Fabricius)
24	*Junonia iphita* (Cramer)
25	*Junonia lemonias* (Linnaeus)
26	*Junonia orithya* (Linnaeus)
27	*Limenitis procris* (Cramer)
28	*Mycalesis perseus* (Fabricius)
29	*Neptis hylas* (Linnaeus)
30	*Ypthima baldus* (Fabricius)
	Papilionidae (2)
31	*Papilio demoleus* Linnaeus
32	*Papilio polytes* Linnaeus
	Pieridae (5)
33	*Delias eucharis* (Linnaeus)
34	*Eurema blanda* (Boisduval)
35	*Eurema hecabe* (Linnaeus)
36	*Eurema laeta* (Boisduval)
37	*Leptosia nina* (Fabricius)

were identified with the help of available literature.

RESULTS AND DISCUSSION

Present study shows 37 species of butterfly belonging to 5 families from College of Material Management (CMM) Jabalpur, Madhya Pradesh. This is the first study from the CMM, this study will also going to enhance the faunal diversity of Jabalpur. Due large diversity of flowering plants we found the large numbers of butterflies in this area.

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STUDY OF PHYSICO-CHEMICAL CHARACTERISTICS OF LITCHI AND BEETROOT FRUIT

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ABSTRACT

The present investigation was undertaken to find out physico-chemical characteristics of litchi and beetroot fruit. The various parameters like fruit size (length and breadth), fruit weight, pulp-stone ratio, TSS, pH,titratable acidity, reducing sugar, total sugars, ascorbic acid, phosphorus, iron, anthocyanin and ash content of litchi fruit were assessed. However, parameters *viz.,* TSS, pH, titratable acidity, reducing sugar, total sugars, ascorbic acid, phosphorus, iron, anthocyanin and ash content of beetroot were analyzed.

Keywords: *Litchi, beetroot, physico-chemical composition*

INTRODUCTION

Litchi (*Litchi chinensis*Sonn.) is a subtropical Asian fruit,which is in high demand for its appealing natural red color,sweet taste and aroma (Kour et al., 2017). It is highly specific to climatic requirements and probably due to this reason its cultivation is restricted to few countries in the world (Menzelet al., 1988). China is the leading litchi producing country in the world with an annual production of 950,000 tons but other countries such as South Africa, Israel, Madagascar, Mauritius, USA, Australia India, Pakistan, the Philippines, Thailand, Taiwan, Indonesia, Vietnam and Brazil also have considerable production of litchi (Menzel, 2001; Lemmer, 2002). The litchi fruit is a good source of food, nutrition. The litchi fruit is also rich source of vitamins C (Wall, 2006) and phenolic compounds that have antioxidant activities (Hu *et al*., 2010) but it may decrease after harvest (Taylor, 1993).

Beetroot (*Beta vulgaris*) is botanically classified as an herbaceous biennial from Chenopodiaceae family and has several varieties with bulb colors ranging from yellow to red. Deep red-colored beet roots are the most popular for human consumption, both cooked and raw as salad or juice (Singh and Hathan,2014). Beetroot should be obtained fresh and grated or juice for maximum benefits (Koch, 2011). Beetroot generally called as garden beet, it is a juicy root vegetable in two colour-deep red and violet beetroot is a native of Europe, used by Greeks and Romans thousand years back. It is now cultivated for its nutritional foods. Beetroot juice is useful in anemia as it forms blood owing to substantial iron. It triggers and activates the R.B.C., pusher fresh oxygen into the body and enhances lung function for normal breathing. The juice of the red beet enhances body's power of resistance (Ahmad and Sharma, 2008).The usually deep-red roots of beetroot are eaten boiled either as a cooked

vegetable, or as salad after cooking and adding oil and vinegar, or raw and shredded, either alone or combined with any salad vegetable. A large proportion of the commercial production is processed into boiled and sterilized beets or into pickles. In Eastern Europe, beet soup, such as cold borscht, is a popular dish. Yellow-coloured beetroots are grown on a very small scale for home consumption (Chibber et al., 2019). Therefore, efforts have been made to study the physico-chemical attributes of litchi and beetroot fruit.

MATERIALS AND METHODS

Good quality fully ripened fresh litchi fruits were collected from orchard of Division of Fruit science, faculty of Agriculture, SKUAST-J. Beetroots were purchased from Narwal Mandi Jammu and transported to Fruit Processing Training Centre, Division of Food Science and Technology, SKUAST-Jammu for the study of physico-chemical characteristics of litchi and beetroot fruit. The fruit length and breadth was determined by using Vernier calipers and expressed in cm.The fruit weight was estimated with the help of an electronic balance (g).Pulp stoneratiowas obtained by dividing the pulp weight by stone weight. The total soluble solids content of fruits were measured with the help of a hand refractrometer. Total titratable acidity and ascorbic acid was determined by AOAC(2000). Sugars were estimated by Lane and Eynon method and anthocyanin as measured by Ranganna (1994). Phosphorus and iron content were determined by Singh *et al*., 1999.

RESULTS AND DISCUSSION

The data pertaining to physico-chemical characteristics of litchi fruit juice revealed that average fruit length, breadth and weight of litchi fruit was 3.86cm, 3.39cm and 17.89g, respectively (Table 1) whereas average pulp-seed ratio was observed as 4.6in litchi pulp which were in accordance with the findings of Islam et al. (2003), Vijayanandet al. (2010) and Singh and Nath (2012) in litchi juice.

Table - 1 : Physico-chemical analysis of litchi juice and pulp

Characteristics	Litchi	
	Juice	Pulp
Length (cm)	3.86	--
Breadth (cm)	3.39	--
Weight (g)	17.89	--
Pulp seed ratio	--	4.6
TSS (^{o}Brix)	16.30	16.20
pH	3.9	3.95
Titratable acidity (%)	0.40	0.36
Reducing sugar (%)	6.80	6.60
Total sugar (%)	12.09	11.90
Ascorbic acid (mg/100ml)	32.50	31.50
Phosphorous (mg/100ml)	240	240
Iron (mg/100ml)	0.28	0.33
Anthocyanin (mg/100ml)	0.48	0.50
Ash (%)	0.52	0.68

Table - 2 : Physico-chemical analysis of beetroot juice and pulp

Characteristics	Beetroot	
	Juice	Pulp
TSS (^{o}Brix)	6.45	6.45
pH	6.5	6.4
Titratable acidity (%)	0.13	0.12
Reducing sugar (%)	0.78	0.80
Total sugar (%)	7.40	7.55
Ascorbic acid (mg/100ml)	3.60	3.50
Phosphorus (mg/100ml)	34.0	35.0
Iron (mg/100ml)	0.40	0.42
Ash (%)	0.74	0.97

The total soluble solids, reducing sugar and total sugar of freshly prepared litchi juice and pulp were found to be 16.30 and 16.20 °Brix, 6.80 and 6.60 percent, and 12.09 and 11.90 percent, respectively, which were in close compliance to the findings of Haq and Rab (2012) and Reshi(2008) in litchi juice. Titratable acidity, pH and ascorbic acid of litchi juice were recorded as 0.40 and 0.36 per cent 3.90 and 3.95, 32.50and 31.50 mg/100ml, anthocyanin, iron and phosphorous content were found to be 0.48 and 0.50 mg/100ml, 0.28and 0.33mg/100ml and 240 and 240mg/100ml, respectively in litchi juice and pulpwhich were in conformity with the findings of Reshi(2008) and Zenget al.(2008) in fresh litchi juice. The ash content of 0.52 and 0.68% was found in fresh litchi juice and pulp.

The data pertaining to Table-2 showed that the Total soluble solids, pH, acidity, ascorbic acid, of beetroot juice was found to be 6.45 and 6.45 °Brix, 6.5 and 6.4, 0.13 and 0.12 percent and 3.60 and 3.50mg/100ml respectively which were in close compliance to the findings of Thakur and Das Gupta (2005) and Gupta, 2019. Total sugars, reducing sugars, iron and phosphorous content of 7.40 and 7.55 percent, 0.78 and 0.80 percent, 0.40 and 0.42 mg/100ml and 34 and 35 mg/100ml respectively was recorded in beetroot juice and pulp.Similar findings of Thakur and Das Gupta (2005), Wrusset al., (2015), Rodriguez-Rodriguez-Sevillaet al., (1999) in beetroot juice. Kathiravanet al., 2014 reported that total soluble solids of 12°Brix, pH 4.21 and acidity 0.11percent in beetroot juice. Theash content of 0.74 and 0.97 percent was found in fresh beetroot juice and pulp.

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INTEGRATED NUTRIENT MANAGEMENT FOR SUSTAINABLE CROP PRODUCTION, FOOD SECURITY AND SOIL HEALTH

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ABSTRACT

Moreover, agricultural land and resources of production decreasing day by day while, population increasing in such a way that we cannot be able to provide them quality food. Population pressure on Indian agriculture has increasing cropping intensity. Simultaneously, extent and amount of application of chemical fertilizers has been increased to provide sufficient food of ever increasing population. This has decline soil productivity and sustainability of crop production and also soil ecosystem due to decreases. Several works has already been reported by researchers on the effect of inorganic, organic, bio fertilizers and integrated use of these nutrient sources, separately or in combination for sustainable crop production. It has also been proved that application of chemical fertilizer increased crop yield and bio-fertilizers and organic nutrient sources are improving soil fertility and sustainability. Thus, the integrated approach of nutrient application through inorganic, organic and bio-fertilizers, crop residues, animal manures could be better approach of nutrient management for sustainable crop production with sustaining soil health for future generation. The present study includes the assessment of separate and combined effects of nutrient sources applied through inorganic, organic and bio-fertilizers.

Keywords*: Organic-chemical-bio-fertilizer, INM, balanced fertilization, sustainable crop production*

INTRODUCTION

The world populations will inevitably double by the middle of the twenty first century, that we are soon to enter in the space of just incoming two to three generations. Agriculture is an important key sector for the economic development for most developing countries. It is critically important for ensuring food security, alleviating poverty and conserving the vital natural resources that the world's present and future generations will be entirely dependent upon their survival and well-being. Over 90% of the developing nations, especially Asian continental, the population pressure will be much more than other part of the world (Rothschild, 1998) due higher growth rate. Moreover, agricultural land and resources of production decreasing day by day while, population increasing in such a way that we cannot be able to provide them quality food. Thus, this is a real time to think about our production resources for sustaining

quality yield.

Sustainable and rational management of agro-phytocenoses depends on various bio-indices and methods of nutrient application, particularly the development and protection of soil resources. Plant nutrients are essential in the crop production, soil health and healthy food for the world's increasing population. For supply of plant nutrients, inorganic (chemical fertilizer), organic and bio-fertilizers are used and each have its advantages and disadvantages in the context of nutrient supply, crop growth and sustainable production and also in sustaining ecosystem. Organic farming and manuring is now becoming an important component of sustainable agriculture (Gorttappech *et al.,* 2000*).* The effective micro-organism performs several important functions in the rhizospheric soil. Micro-organisms are a labile medium of soil C, N, P, S, Zn and provide an immediate sink for these nutrients. Effective micro-organisms encourage plant growth by producing growth regulators, facilitating nutrient uptake, accelerating mineralization, reducing plant stress, stimulating nodulation, providing nitrogen fixation, promoting mycorrhizal fungi, suppressing plant diseases, and functioning as nematicides and insecticides. The effect of organic nutrients on crop yield is long term and not immediate, thus, farmers are reluctant to use organic fertilizers in their cropping system. However, use of effective microorganisms (EM) inoculums along with organic/inorganic materials is an effective technique for stimulating supply and release of nutrients from these nutrient sources. Some studies have shown that the inoculation of agro-ecosystems with bio-inoculants cultures can improve soil and crop quality (Hussain *et al.*, 1999). Similarly, Daly and Stewart (1999) reported that application of bio-inoculants to onion, pea and sweet corn increased yields by 29%, 31% and 23%, respectively.

Soil organic matter is the major source of plant nutrients in soil. The losses and gains of soil organic matter influenced by some cultural practices such as application of manures (compost, vormi compost, green manuring with legume), incorporation of crop residues, tillage operation and balanced fertilization in cropping system (Manna *et al.,* 2005). The different technologies of agriculture such as organic farming (Lockeretez *et al.*, 1984), sustainable agriculture (Madden, 1987), low input sustainable agriculture (Prasad, 1998) and integrated plant nutrient management (IPNM) has also been introduced for restoration or maintenance of soil fertility and productivity. These all technologies increases transformation, mineralization, recycling and use efficiency of plant nutrients in soil through the use of organic manures, chemical fertilizer and bio-inoculants alone or in combination. However, Higa and Wididana (1991) stated that bio-inoculants separately cannot be substitute for all the components of sustainable crop production but is an additive for optimizing all other amendments and practices used for crop production. Therefore, integration of inorganic, organic and bio-fertilizer in such a order to make optimum use of each type of fertilizer should be better way in balance nutrition for sustainable crop production.

EFFECTS OF INORGANIC SOURCES OF FERTILIZATION

The chemical fertilizers applied for quick reaction in growing crops to increase crop production and it already has been proved by many researchers (Prasad, 1998 and Gorttappech, *et al.*, 2000) that application of chemical fertilizers increased yield. Inorganic nutrient sources (chemical fertilizer) are produced artificially in a chemical refinery containing targeted plant essential elements and some of them also contain non targeted elements. On long-term basis, the use of chemical

fertilizer alone is often associated with reduced yield, soil acidity and nutrient imbalance (Kang *et al.*, 1980, 90) and has however not been helpful under intensive agriculture. Non-targeted elements resulting detrimental effect by the toxic persistent organic pollutants such as Dioxins, polychlorinated dibenzo-p-dioxins, and polychlorinated dibenzofurans have been detected in agricultural fertilizers

(http://www.pirg.org/toxics/reports/wastelands/). Prophetic fertilizers can increase the concentration of lead, arsenic, cadmium, chromium, and nickel in soil (Wilson, 1997). Methane emissions from crop fields (notably rice paddy fields) are increased by the application of ammonium-based fertilizers; these emissions contribute greatly to global climate change as methane is a potent greenhouse gas (Bodelier *et al.*, 1999). Moreover, over application of chemical fertilizers can result in ecological disturbance by increase in nutrient leaching, pollution of water resources, destruction of micro-organisms and friendly insects, crop susceptibility to disease attack, acidification or alkalization of the soil or reduction in soil fertility thus inherent soil fertility and productivity, resulting serious threat to crop sustainability.

EFFECTS OF ORGANIC SOURCES OF FERTILIZATION

When these organisms and plants die, their body is decomposed and protein is degraded into very simple form of nutrients is necessary for proper growth of crop plants. Nitrogen and phosphorus are the most important among organic nutrients. Generally they are supplied to crops by applying manures and fertilizers in the soil. Organic nutrient sources refers to organic materials used as fertilizer that occur regularly in nature, usually animal farm yard manure, compost, vermi compost, bio-fertilizers, green manure with legume, sheep and goat manure, poultry manure, fish manorial cakes, blood and fish meal, wood ash, sewage and sludge, night soil, guano etc. organic fertilizer is most suitable cultivation practice for sustainable agriculture and its advantage and disadvantages is listed below.

ADVANTAGES

1. Organic nutrient source improved physicochemical properties of soil.
2. It enhanced soil biological activity, which improves nutrient mobilization from organic and chemical sources and decomposition of toxic substances.
3. It increased the organic matter content of the soil, therefore improving the exchange capacity of nutrients, increasing soil water retention, promoting soil aggregates and buffering the soil against acidity, alkalinity, salinity, pesticides and toxic heavy metals.
4. The release nutrients slowly due to which it contribute to the residual pool of organic N and P in the soil, reducing N leaching loss and P fixation and also can supply micronutrients.
5. It helps to suppress certain plant diseases particularly soil-borne diseases and parasites.
6. It made from naturally occurring sources, therefore limited amounts of fossil fuels are used in production, potentially lowering the amount of greenhouse gas that is released into the atmosphere.

DISADVANTAGES

1. Nutrient release rate is too slow to meet crop requirements in a short time; hence some nutrient deficiency may occur initially in high yielding verities.
2. Organic fertilizers are comparatively low in nutrient content, so larger volume is needed to provide enough nutrients for crop growth.
3. Generally costs significantly more than

synthetic fertilizer.

4. Organic fertilizers, despite the advantages discussed above, still release nutrients into their surroundings; these nutrients can find their way into local streams, rivers, and estuaries just as nutrients from synthetic sources.

EFFECTIVE BIO-INOCULANTS

It is well-recognized that microbial inoculants constitute an important component of integrated nutrient management that leads to sustainable crop production. Application of microbial stain (termed bio-fertilizer) play a significant role in regulating the dynamics and transformation of organic matter decomposition and the availability of plant nutrients such as N, P, S micro nutrients. In addition, microbial inoculants can be used as an economic input to increase crop productivity and soil fertility; fertilizer doses can be lowered and more nutrients can be harvested from the soil (*Balezentiene and Klimas, 2009.*).

Effective bio-inoculants are defined as a substance which contains living microbial inoculants and its help into expand the root system, vigours crop growth and better seed germination. A healthy plant usually has a healthy rhizosphere which should be dominated by beneficial effective microbes. Conversely, in unhealthy soil, dominated by pathogenic microbes, optimum plant growth would not be possible. Effective micro-organisms are as beneficial bio-fertilizers these are differ from chemical and organic fertilizers in the sense that they do not directly supply any nutrients to crops and are used the special cultures media of microbes. The effective micro-organisms are relatively simple and installation cost is very low compared to chemical fertilizer plants. The some effective bio-inoculants (Table-1) and their functions and uses are given below

Table - 1 : Effective micro-organisms used as bio fertilizers and their functions/uses

Effective bio-inoculants	Use/Function
Acetobacter sp.	Nitrogen Fixation
Aspergillus sp.	Nutrient Uptake/Availability
Athrobacter sp.	Growth, Vigor
Azospirillum sp.	Yield
Azotobacter sp.	Establishment/Vigor
Bacillus sp.	Growth, Insecticide, Fungicide
Beauvaria sp.	Insecticide
Gigaspora sp., *Glomus* sp., *Pisolithus* sp.	Growth
Paecilomyces sp.	Nematicide
Phosphobacteria sp.	Phosphorus Solubilization
Pseudomonas sp.	Disease Control
Rhizopogon sp.	Disease Suppression
Effective bio-inoculants	Use/Function
Trichoderma sp., *Gliocladium* sp.	Fungicide

INTEGRATED USE OF ORGANIC, INORGANIC AND BIOLOGICAL NUTRIENT SOURCES FOR CROP PRODUCTION

The nutrients present in organic combinations are released into soil solution through mineralization of organic matter by microorganisms. The nutrients absorbed by plants from the soil are stored in above-and below-ground biomass. When dead plants and animals enter soil, they are again broken down by various soil microorganisms, which use them as substrates for energy and also as nutrients sources in the synthesis of new cells, and the nutrients are again released into soil solution and the cycle continues. Prior to introduction of high yielding varieties of crops, farmers using organic sources with efficient bio-inoculants for recycling of plant nutrients in soil. However, due to the entry of high yielding varieties and fertilizer responsive cultivars, traditional practices such as the use of organic materials and application of organic manures were replaced with inorganic fertilizers. This has, however raised

concerns about the potential long term effect on soil productivity, soil fertility and environmental quality (Prasad and power, 1995). Moreover, the continuous depilation of nutrients in the soil system, strategies for integration of nutrient sources can improve and enhances crop productivity and soil fertility. Also, it is well justified that the integrated plant nutrient management can better adjustment of soil fertility and plant nutrient supply to achieve an optimum crop production from all possible sources of plant nutrients into sustainable manner. Prasad and Singh (1984) conducted a pot experiment on paddy showed that incorporation of organic as *azolla* as green manure, effective bio-inoculants as seedling wit *Azotobacter* and *Azospirillum* and reported that inorganic application of nitrogen as independent treatment or in combination with each other increased the growth and yield attributes and enhanced the nutrient uptake by grains. They showed, in the all treatments the combine use the organic, inorganic and microbial strain remarkably maintained its superiority over the other treatments. Zaidi *et al.* (2004) reported that dual inoculation of N2 fixer *A. chroococcum* and AMF *G. fasciculatum,* stimulated plant growth and increased N and P uptake by green gram (*Vigna radiata L. Wilczek*). Khan and Zaidi (2007) demonstrated the benefits of triple inoculation of *A. chroococcum*, *Bacillus sp.* and *G. fasciculatum* on wheat yield, N and P concentrations and quality of wheat grains. In the presence of effective-organisms in soil makes the soil a living system. Soil organisms contribute a wide range of essential services to the sustainable functioning. They act as the driving agents of nutrient cycling and transformations, regulating the dynamics of soil organic matter and soil carbon sequestration, improving the soil physical, chemical and biological properties and enhancing plant and soil health.

CONCLUSION

In the presence of effective-organisms in soil makes the soil a living system. Soil organisms contribute a wide range of essential services to the sustainable functioning of all ecosystems regulating the chemical and biological equilibrium of the Earth. The most effective plant nutrition management should ensure both enhanced and sustainable agricultural production for our end ever increasing population and also it is a challenge before us to reach the goal of sustainable agriculture. The answer only is the integrated use of plant nutrient sources viz. organic, inorganic fertilizer and effective micro-organism. Practicing it only can improve nutrient supply, soil quality, crop growth and production into sustainable manner with of all ecosystems, regulating the chemical and biological equilibrium of the Earth.

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EFFECT OF DRAIN WATER IN SHAHGANJ MUNICIPAL BOARD JAUNPUR IN DIFFERENT SEASONAL BIOCHEMICAL STUDY

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ABSTRACT

The drain ecosystem controls the moisture of soil, humidity of air and temperature on one hand and furnishes requite nutrients on the other hand. Thus it imparts a high bio-diversity and life to plant and animals in its surrounding of India. It is one among those developing countries which are facing severe problem of water pollution. Most of the industries discharge their effluent without proper treatment into nearby water bodies which detorites the quality of water. The safe portable water is absolutely essential for healthy life. The study area selected was different water bodies of Shahganj, (Uttar Pradesh, India). These are one of the important sources of drinking water supply for the Shahganj tehsil. It fulfills the drinking water needs of about 65 per cent of the city population. In addition to this it also serves the irrigation purpose of Shahganj tehsil and the surrounding areas. Attempts were made to study and analyze the Bio-chemical characteristics of the water.

Keywords **:** *Water, soil, chemical, temperature.*

INTRODUCTION

In a soil condition characterized by high concentrations of soluble salts and play the essential role in tolerance to abiotic stresses. Samples were collected and analysed (APHA1995, NEER1 1995) for the Bio-chemical parameters, temperature, pH, turbidity, total alkalinity, total hardness, calcium hardness as $CaCO_3$, magnesium hardness as $CaCO_3$, chlorides, iron, manganese and sulphate in three different seasons to ascertain the drinking water quality. The study reveals that the Bio-chemical parameters of water tested are well with in the WHO limits except for turbidity and it is a good quality for drinking irrigation and fish culture purposes.

Shahganj is a Tehsil of Jaunpur District, It is one of the fastest small Industrial growing cities in the country. Water quality is an index of health and well being of a society. Industrialization, urbanization and modern agriculture practices have direct impact on the water resources. These factors influence the water resources quantitatively and qualitatively. The study area selected different water bodies of Shahganj tehsil of Jaunpur.

MATERIALS AND METHODS

The study areas selected was different water bodies in Shahganj (U.P.). Water samples was analyzed for 11 parameters such as temperature,

turbidity, pH, total alkalinity, chloride, total hardness, calcium hardness, magnesium hardness, iron, manganese and sulphate. Sampling and physicochemical investigation was carried out according to standard methods (APHA 1995; NEERI 1991). The results were carefully studied and analyzed and compared with WHO Standards & BIS Standards with special reference to drinking suitability.

- Water temperature was recorded in the field using sensitive mercury thermometer.
- The pH of the samples was determined using digital pH meter.
- Turbidity was determined by Nephelo-turbidity meter.
- Total Hardness, calcium hardness and magnesium hardness was determined titrimetrically using EDTA method (APHA 1995).
- Total Alkalinity was determined by titrimetric method.
- Chlorides were determined by Mohr's argentometry method (APHA 1995).
- Iron, manganese and sulphate was determined by spectrophotometrically.

Table - 1 : Seasonal study of Bio-chemical parameters

S.No	Parameters	WHO Standards	BIS Standards	Rainy Season	Winter Seas on	Summer Season
1	Temperature	-	-	22.2	23.0	31.0
2	Turbidity	7	13	133	3.7	5.3
3	Ph	7-8.5	6.5-8.5	7.60	7.74	7.45
4	Total	212	630	130	115	128
5	Total	104	615	128	117	128
6	Ca hardness	78	205	60	72	90
7	Mg hardness	75	73	68	40	35
8	Chlorides	255	1000	15	15	16
9	Iron	1.0	.05	0.05	0.05	0.28
10	Manganese	0.5	0.5	0.22	0.17	0.46
11	Sulphate	255	410	8.0	5.0	6.0

RESULTS AND DISCUSSION

The observations and results of analysis of various Bio-chemical parameters of water of different water bodies of Shahganj was summarized in table 1 and they are also analyzed graphically. The data revealed that there were considerable variations in physicochemical parameters from season to season. A comparison of the various Bio-chemical characteristics of the studied water samples has been made with the WHO (1984) and BIS (1998) standards. These parameters are discussed below:

Temperature

The maximum temperature of water was recorded in summer season which is 29,8°C. The variation in water temperature may be due to difference in timing of collection and the influence of season (Jayaraman et al. 2003). Temperature controls behavioral characteristics of organisms, solubility of gases and salts in water. No other factor has so much influence as temperature (Welch 1952).

Turbidity

The amount of suspended material in water can be measured by collecting the solids or

assessing the relative light transmission of the suspension. The increased opaqueness is caused by increased sediment which negatively affect many aquatic organisms. Both algal production and fish reproduction and feeding can become diminished and some organisms, like shell-fish (continual filter-feeders) can become choked by sediment and eventually die in heavily turbid waters. The maximum value of turbidity was observed in rainy season (128 NTU) which is much higher than the permissible limit as prescribed by WHO. Water may not be safe from hygienic point of view as under such conditions it becomes very difficult to maintain the minimum desirable limit of chlorine in the water.

Hydrogen Ion concentration pH :

pH is a unit that expresses the strength of a solution based on its acidic or basic properties. Aquatic organisms can only function in a particular range of pH, and become forced to relocate when the surrounding water changes. Pollution from burning fossil fuels increases the amounts of sulphur and nitrogen oxides introduced into the water. thereby increasing the overall acidity. WHO has recommended maximum permissible limit of pH from 6.4 to 9.5 (De, 2010). pH correction after the treatment of water can significantly reduce the corrosion and incrustation problems. The pH controls the chemical state of many nutrient including dissolved oxygen, phosphate, nitrate etc. (Goldmann and Home, 1983). It regulates most of the biological processes and biochemical reaction. (Verma et al., 2006). The pH was found in the range of 7.844 to 7.85 i.e. it has pH values within the desirable and suitable range.

Total alkalinity

The alkalinity of water is its capacity to neutralize acids. The maximum alkalinity was recorded as 126 ppm in rainy season. BIS has set a desirable level of alkalinity in drinking water to be 200 ppm where as its value has been prescribed to be 600 ppm in the absence of alternative source. The alkalinity fluctuated in accordance with the fluctuation in the pollution load.

Total hardness

The maximum total hardness was recorded as 125 ppm in rainy season and the minimum value was recorded as 113 ppm in winter season. The hardness of water is not a pollution parameter but indicates water quality. Hardness Is an important parameter in decreasing the toxic effects of poisonous elements. It is within desirable limit. BIS has prescribed desirable limit of total hardness 300 mg/I and permissible limit in the absence of alternate source 600 mg/1 (De, 2010).

Calcium hardness

Its value was found in the range of 57 mg/I to 87 mg/I & it is with in the permissible limit as prescribed by WHO.

Magnesium hardness

Its value was found in the range of 35 to 68 mg/1. Its value is with in the permissible limit as prescribed by WHO.

Chloride

Chloride occurs in all natural waters in widely varying concentrations. The chloride contents normally increases as the mineral contents increases (Dubey 2003). In the present study the chloride concentrations were found in the range of 09-10 ppm.

Iron

Its value was found in the range of 0.5 mg/1 to 0.28mg'L It is with in the permissible limit as prescribed by WHO.

Manganese

Manganese is essential element which does not occur as a metal naturally but it is found in the form of salts and minerals. Its deficiency cause

bones abnormalities and reproductive dysfunction. The maximum concentration of manganese was recorded as 0.46 ppm in summer season and the minimum value was recorded as 0.22 ppm in rainy season, which is well with in the permissible limits as prescribed by WHO.

Sulphate

It usually occurs in natural waters. The presence of sodium sulphate and magnesium sulphate in drinking water beyond the permissible limits may cause cathartic action. The value of sulphate was found in the range of 5.0 mg/1 to 7.0 mg/1. Its value is much lower than the permissible limit as prescribed by WHO.

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PREVALENCE OF SELECTED PATHOGEN IN STREET VENDED FOOD PRODUCT (CHOLE MATAR) OF JABALPUR CITY

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ABSTRACT

The purpose of this study was to determine the microbiological quality of 'Chhole Matar' sold by street vendors in Jabalpur city. A total of 10 samples, of 'Chhole Matar' from different areas in Jabalpur city were collected in sterile containers and analyzed using standard microbiological method of standard plate count (nutrient agar), yeast mould count (Potato dextrose agar), pathogen in Cfu/g (Hi Touch Hexachrome Flexiplate), total coliform count in MPN/g (LST broth).

Keywords: *Chhole matar, Jabalpur, plate count.*

INTRODUCTION

Street food has been defined as *'ready to eat,* food prepared and sold by vendor and hawker especially in street and other similar public for immediate consumption at later time without further processing or preparation (WHO, 1996), (Bhatt *et al.* 2000). For the purpose of examining the hygiene condition and microbial quality of street food the project was conducted for *enumerate standard plate count in sample-* 'Chhole matar', *e*numerate Yeast and Mould count in sample- 'Chhole matar', Enumeration of Coliform count in sample - 'Chhole matar' , *enumerate following pathogens: E.coli*, *Enterococcus faecalis*, *Proteus mirabilis*, *Pseudomona aeroginosa*, *Staphylococcus aureus* (Ahmed *et al*. 2000). Kushwaha and Mustafa, 2012 a and b gave a significant result about the food quality of Chole matar and Aam pana of street foods of Jabalpur city.

MATERIALS AND METHODS

The present study was undertaken to examine the microbiological quality of 'Chole matar' sold in Jabalpur city. During the survey, 10 samples were collected from different locations in the city. This sample was collected in sterile sample bottles aseptically and promptly cooled to about 4ºC till they were subjected to laboratory analysis (Ranganna 1977) by using various standard methods (AOAC 1984). The different Local areas selected were Civil Lines, Jabalpur Railway Station, Pandit Deen Dayal Upadhyay Inter State Bus Terminus (ISBT), Garha, Gorakhpur, Gwarighat, Sadar Choupati, Ghamapur, Adhartal and Ranhji.

RESULTS AND DISCUSSION

The present investigation was conducted to study the details of occurrence of total bacterial, yeast and mould, coliform and pathogen in 'Chhole Matar' sample procured from 10 different locations in Jabalpur city. The specific findings of study are being discussed.

Pathogenic bacteria (CFU/g) range and mean of Chhole matar:

Sample from 7 different location of Jabalpur city were selected & enumeration of pathogenic bacteria. The *Escherichia coli* count ranged from 0 to$3x10^3$ CFU/g with the mean of $1.5\pm0.14x10^3$. Among 7 samples, 3 samples were found to be satisfactory (less than 20) 4 were unsatisfactory as *E.coli* count is more than 100 as per PHLS guidelines (Gilbert et al., 2000). Tambekar *et al*. (2008) reported that high incident of *E.Coli* might be due to contaminated water supply through poor hand washing and contamination of utensils

Table - 1 : Showing pathogenic bacteria (CFU/g) range and mean in Chole Matar sample in street of Jabalpur city.

Sample area	*Escherichia coli* (10^3)	*Proteus mirabilis* (10^3)	*Klebsiella pneumonia* (10^3)	*Pseudomonas aeruginosa* (10^3)	*Staphylococcus aureus* (10^3)	*Enterococcus faecalis* (10^3)
1 (Civil Lines)	0	2	1	3	4	3
2 (Jabalpur Railway Station)	2	4	3	0	5	5
3 (ISBT)	1	2	1	2	2	0
4 (Gorakhpur)	0	3	2	1	2	4
5 (Gwarighat)	0	2	2	0	3	2
6 (Adhartal)	3	5	5	6	7	6
7 (Ranjhi)	2	2	3	2	2	2
Maximum	3	5	5	6	7	6
Minimum	0	2	1	0	2	0
Mean ± SE	1.14±0.17	2.85±0.17	2.42±0.19	2.±0.29	3.57±0.27	3.14±0.29

SPC, YMC and MPN count of Chhole matar:

Standard plate count of *chhole matar* Ranged from $4.3x10^4$ to $7500x10^4$ Cfu/g with the average value of $802.2x10^4\pm2.3x10^4$ Cfu/g. Yeast & mould count was found to range between $0.2x10^4$ to $98x10^4$ Cfu/g. The Average Yeast Mould Count present in *chhole matar* samples were $13.6x10^4\pm0.2x10^4$ Cfu/g**.** The Comparative study of *chhole matar* sold in different areas of Jabalpur city showed maximum SPC count & YMC count in samples collected from railway station. High total SPC of *chhole matar* sample indicate very poor hygienic quality of production & handling. The total coliform count of the *Chhole matar* sample ranged from 43 to 210 (MPN/g) and the average was 105±6.2. Orallo *et al.*, 1999 suggested the presence of coliform bacteria due to negligence such as poor sanitation during preparation & storage of production use of dirty utensils & bare hands in preparation of product may also lead such contamination.

Table - 1.3 : Standard plate count, Yeast and Mould count (CFU/g) and Most probable Number (MPN/g) of total coliform of 'Chole matar''

Sample area	SPC(CFU/g)	YMC(CFU/g)	Total Coliform (MPN/g)
1 (Civil Lines)	$29.7x10^4$	$2.2x10^4$	39
2 (Jabalpur Railway Station)	$330.5x10^4$	$24.4x10^4$	150
3 (ISBT)	$2.8x10^4$	$2.3x10^4$	43
4 (Garha)	$3.3x10^4$	$2.6x10^4$	43
5 (Gorakhpur)	$320.5x10^4$	$32.9x10^4$	75
6 (Gwarighat)	$30.2x10^4$	$21x10^4$	93
7 (Sadar Choupati)	$59.4x10^4$	$39x10^4$	150
8 (Ghamapur)	$315.5x10^4$	$317.5x10^4$	150
9 (Adhartal)	$28.5x10^4$	$11.1x10^4$	93
10 (Ranjhi)	$17.3x10^4$	$2.8x10^4$	150
Maximum	$330.5x10^4$	$317.5x10^4$	150
Minimum	$2.8x10^4$	$2.3x10^4$	43
Mean±SE	$113.7x10^4 \pm 14.4x10^4$	$45.6x10^4 \pm 9.6x10^4$	98.6±4.8

Table - 2 : Microbiological quality of 'Chhole matar' sample in streets of Jabalpur on the basis of SPC

Sample Area	Microbiological quality (CFU/g) as per PHLS guidelines		
	Satisfactory $<10^4$	Acceptable $10^4 \leq 10^5$	Unsatisfactory $\geq 10^5$
Chole matar (10)	5	5	_

Pathogen Test

The pathogenic count was done using readymade Hi Touch Hexachrome Flexi plate for differentiation of six pathogenic organisms - *E. coli, Enterococcus faecalis, Klebsiella pneumoniae, Proteus mirabilis, Pseudomonas aeruginosa, and Staphylococcus aureus*. The plates are inoculated using 0.1ml of sample and inoculated at 35-37ºC for 18-24 hrs and the differentiation was done on the basis of colour of colonies.

Table - 3 : List of Pathogents

Organisms	Colour of colony
Escherichia coli	Pink-red
Enterococcus faecalis	Blue(small)
Klebsiella pneumonia	Blue-purple (mucoid)
Proteus mirabilis	Light brown
Pseudomonas aeruginosa	Colourless
Staphylococcus aureus	Golden yellow

Table - 4 : Pathogenic Count

sample	No. tested	No. contaminated	*Escheria coli*	*p.mirabilis*	*Klebsiella pnemoniae*	*Pseudomonas aeruginosa*	*Staphylococcus aureus*	*Enterococcus faecalis*
Chole matar	7	7	4(55.5%)	7(100%)	7(100%)	5(71.1%)	7(100%)	6(85.5%)

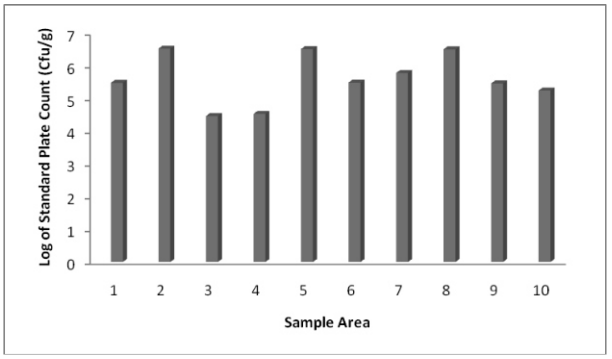

Fig. - 1.3 : Standard Plate Count of *Chole matar*

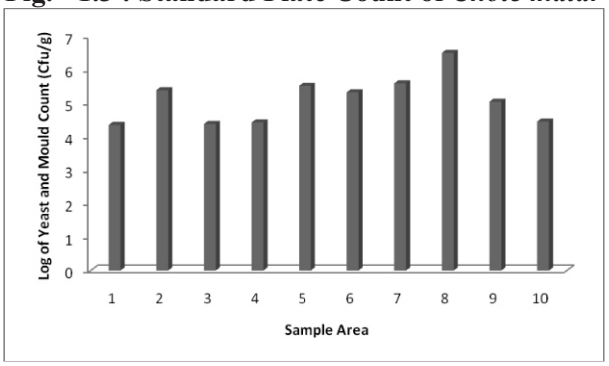

Fig. - 1.4 : Yeast and Mould Count of *Chole matar*

Sample Area

1. Civil Lines
2. Jabalpur Railway Station
3. Pandit Deen Dayal Upadhyay Inter State Bus Terminus (ISBT)
4. Garha
5. Gorakhpur
6. Gwarighat
7. Sadar Choupati
8. Ghamapur
9. Adhartal and
10. Ranhji

DISCUSSION

The microbial quality of *Chhole matar* samples, on the basis of SPC among 10 samples of *Chhole matar* ,1 was found to be satisfactory, 8 acceptable and 1 sample were unsatisfactory range.

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EVALUATION OF SELECTED PLANT EXTRACTS TREATED ON ONION BULBS (ALLIUM CEPA. L.) AGAINST BLACK MOLD CAUSED BY ASPERGILLUS NIGER IN-VITRO

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ABSTRACT

***In-vitro* experiments were done in the department of Plant Pathology SHUATS, Prayagraj under DST funded project for the farm women. Seeds extracts of *Nigella sativa,* (black cumin) Ajwain (*Trachyspermum ammi*) and the leaf extract of Tejpatta (Bay leaves) at 5 % concentrations were prepared and introduced to healthy onion bulbs collected from the farmer's fields by making 3 holes of 5 mm with the help of cork borer further concentration of the plant extracts were sprayed to the holes and kept it for air dry for 1 hour inside the laminar air flow. With the help of the cork borer mycelium were taken from the pure culture of *Aspergillus niger* and inoculated in the hole of onion bulbs. Evaluation of *Nigella sativa,* Ajwain and Tejpatta showed the maximum inhibition of radial growth of *Aspergillus niger* mycelia was found in T_1 treatment *N. sativa* (88.31%) followed by T_2 Ajwain of (77.28%) and T_3Tez patta (39.30%).The treatments were found significantly superior as compared to T_0– control (0%).**

Keywords : *Allium cepa*, *aspergillus niger, bay leaves, nigella sativa and trachyspermum ammi.*

INTRODUCTION

Onion (*Allium cepa* L.) is one of the most important and familiar spice (family-Alliaceae) crops throughout the world. An important vegetable crop based on consumption and economic value to farmers. Onion is grown for its bulbs daily used in every kitchen for salads, seasoning and flavouring of foods raw as well as cooked. Onion content sugars, vitamins and minerals which are valuable ingredient in the diet (Ole *et al*., 2004.) The crop is grown mainly during *Rabi* season (October to April). In most of the countries onions are harvested once a year needing its storage where it loses weight due to continuous loss of water and dry matter. The most serious loss arises from storage rots due to bulb rotting microorganisms and also from unwanted sprouting (Jones and Mann, 1963). About 15 different fungal species are reported responsible for the onion diseases in the storage and transit all over the world for which the loss may go up to 40% (Aiyer, 1980). The most destructive diseases in storage are black mould rot (*Aspergillus niger*), blue mould rot (*Penicillium* spp.), *Fusarium* bulb rot (*Fusarium* spp.) basal rot (*Fusarium monilifome*),

Aspergillus rot (*Aspergillus* spp.) etc. The objective of this experiment is to evaluate selected plant extracts treated on onion bulbs against black mold caused by *Aspergillus niger.* Among these diseases black mould disease is disease caused by *Aspergillus niger* is a limiting factor in onion (*Allium cepa* L.) production worldwide (Ozer and Koycu 2004). (Srinivasan and Shanmugam 2006). Reported that *Aspergillus niger* a soil saphrophyte (on decaying organic matter) survive in onion crops infield or on onion bulbs, in storage.

MATERIALS AND METHODS

The present study was conducted *in-vitro* at Department of Plant Pathology, Sam Higginbottom University of Agriculture, Technology and Sciences, during the *Rabi* season in 2016-17. *In – vitro* experiment was laid-out with three replications of concentration 5% of *Nigella sativa* (black cumin seed), concentration 5% of Ajwain (*Trachyspermum ammi* seed) and 5%concentration of Tej patta (Bay leaves) were prepared and introduced to healthy onion bulbs making 3 holes of 5mm with the help of cork borer further concentration of the plant extract were sprayed to the holes and kept it for air dry for 1 hour inside the laminar air flow. With the help of the cork borer mycelium were taken from the pure culture of *Aspergillus niger* and inoculated in the hole of onion bulb.

Details of treatments

S. N.	Treatments	Replications			Concentration
T_1	*Nigella sativa*	R1	R2	R3	5%
T_2	Ajwain	R1	R2	R3	5%
T_3	Tej patta	R1	R2	R3	5 %
T_0	Control	R1	R2	R3	-

Formula used -

$$\text{Antifungal index (\%)} = \frac{Dc - Dt}{Dc} \times 100$$

Where:

Dc = Average increase in mycelial growth in control

Dt = Average increase in mycelial growth in treatment

Observations were recorded on the spread of *Aspergillus niger* mycelial growth on the bulb of the onion at every 24 hours up to 5 days.

RESULTS AND DISCUSSION

In-vitro experiments were done by using the onion bulbs which were collected from farmer's field for further studies. Evaluation of seed extracts of *Nigella sativa, Ajwain* and the leaf extract of *Tejpatta* at 5 % concentration against *Aspergillus niger* (black mold) showed in the table below.

Table 2- *In-vitro* evaluation of botanical extracts on radial growth mycelia of *Aspergillus niger.*

	Treatment	concentration	Replications			Radial growth of Pathogen (mm)	Mycelial inhibition (%)
			R_1	R_2	R_3		
T_1	*Nigella sativa*	0.5	2.5	3.5	3	3.00^c	88.31
T_2	Ajwain	0.5	7.5	5	5	5.83^c	77.28
T_3	Tez patta	0.5	12.25	17	17.5	15.58^b	39.30
T_0	Control (untreated)	0	27.5	27.5	22	25.67^a	0
S.Em (±)		-	-	-	-	**2.792**	
C.D(5%)		-	-	-	-	**4.310**	

The maximum inhibition of *Aspergillus niger* radial growth of mycelia was found in T_1 treatment *N. sativa* (88.31%) followed by T_2 Ajwain of (77.28%) and T_3Tez patta (39.30%).The treatments were found significantly superior as compared to T_0– control (0%).

Observation were taken to check the inhibition of *A. niger* by selected botanicals

Use of botanical extracts to control mycelia growth of *A. niger* is a potential, non- chemical means of controlling plant disease by reducing inoculum levels of the pathogens. In the present investigation, use plant extracts of *N. sativa,* Ajwain and Tez patta *at* 5% concentrations it was observed that *N. sativa* found effective in comparison to control. This could be obviously due to several possibilities of existence of microbial interactions such as stimulation, inhibition, mutual intermingling of growth of antagonistic isolate over test pathogen etc. have been enumerated by many workers (Maraqa *et al.,* 2007, Nagerabi *et al.,* (2011). Both the postharvest diseases i.e. black mold rot and blue mold rot encountered are caused by fungi. This finding agrees with the observation made by Kumar *et al.,* (2015). They reported that about 35-40 % onion is lost due to damage caused by storage diseases.

CONCLUSION

This investigation has shown that the sterilized leaf extracts of *N. sativa,* Ajwain and Tez patta *at* 5% concentrations were found to be effective in reducing the mycelial growth of the various postharvest fungal pathogen of onion. All leaf extracts significantly inhibited the radial mycelial growth of the test pathogen at 120 hours after inoculation. Leaf extract of *N. sativa* was able to inhibit the radial mycelial growth of *A. niger* by *N. sativa* (88.31%) followed by T_2 Ajwain of (77.28%) and T_3Tez patta (39.30%).The treatments were found significantly superior as compared to T_0 – control (0%). There was significant difference between all treatments.

The use of chemical fungicides is the most common choice for management of black mold disease, but this should be avoided as onion crop is used as raw food item in salads and vegetables around the world also causes the development of fungal resistance. In addition, continuous and inappropriate use of chemical fungicides to manage black mold disease is not considered to be the long-term solution because this can increase the investment expenses, the risk of having high levels of toxic residues, Among these rot-inducing fungi, *A. niger* was the most frequently encountered pathogen. Leaf extract of *N. sativa* at 5% concentration was found as best treatment to control the causal organism of black mold rots of onion and also the concerns in human health and environmental settings.

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STUDY OF FLORAL DIVERSITY OF DUMNA NATURE RESERVE, JABALPUR (Madhya Pradesh)

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ABSTRACT

The present paper is based on a collection of floral as well as faunal diversity from Dumna Nature Reserve, Jabalpur, M.P. It comprises an account of several species of different groups of flora from the study site by the method of sighting. This study comprises total 149 plant species form Dumna Nature Park.

Keywords *: Dumna nature reserve, jabalpur, floral diversity.*

INTRODUCTION

The Dumna Nature Reserve or DNR is one of the largest areas of natural greenery and unspoiled forest available near the city of Jabalpur. It covers an area of approximately 1500 acres and is still largely undisturbed by the exploitations. The park has a wide range of ecosystems namely grassland, shrubs, forest as well as aquatic, which houses several types of animal species including a wide range of mammals, reptiles, amphibians and birds. The faunal diversity of DNR includes leopard, jackal, spotted deer, barking deer, wild boar, civet cats, four horned antelope, Indian crocodile etc. This park has a large water reservoir extending across 230 acres and known as Khandari reservoir which is a home of several species of aquatic fauna and flora. The reservoir also provides water to about 1/3rd part of Jabalpur. During winter season, a large number of terrestrial as well as aquatic migratory birds visit DNR every year. It is known as a hub for avian fauna found within the city limits. Many species of plants are found to thrive well within the area. The Dumna Nature Reserve has planned plantation of various exotic species of herbs, shrubs and trees. The faunal diversity is very vast. This is mainly due to desirable ecological circumstance. from floral diversity point of view, 63 tree species, 25 species of shrubs and under shrubs, 34 species of herbs, 10 species of climbers and creepers while 17 grass species were recorded. Earlier work in flora of Madhya Pradesh was done by Verma et al. 1983; Khanna and Kumar, 2000 and 2006; Khanna *et al*, 2001; Wagh and Jain, 2010, 2013 and 2014.

MATERIALS AND METHODS

Almost 2 year regular survey of Dumna Nature Reserve, Jabalpur (Madhya Pradesh), was done by the first author, in this survey we studied many plants in the premises and found a large numbers of plants. Plants were identified on the basis of various literatures.

RESULTS AND DISCUSSION

The present paper is based on a collection of floral as well as faunal diversity from Dumna Nature Reserve, Jabalpur, M.P. It comprises an account of several species of different groups of flora from the study site by the method of sighting. The faunal diversity is very vast. This is mainly due to desirable ecological circumstance. from floral diversity point of view, 63 tree species, 25 species of shrubs and under shrubs, 34 species of herbs, 10 species of climbers and creepers while 17 grass species were recorded.

List of Floral Diversity of Dumna Nature Reserve

S. No.	Common Name	Scientific Name	Family
		Trees (63 sps)	
1	Aam	*Mangifera indica* L.	Anacardiaceae
2	Amaltas	*Cassia fistula* L.	Caesalpiniaceae
3	Amrood	*Psidium guajava* L.	Myrtaceae
4	Arjun	*Terminalia arjuna* (Roxb. ex DC.) Wight & Arn.	Combretaceae
5	Ashok	*Polyalthia longifolia* (Sonn.) Thw	Annonaceae
6	Babul	*Acacia nilotica* (L.) Delile	Leguminosae
7	Bara Nimbu	*Citrus limon* (L.) Burm. f.	Rutaceae
8	Bargad	*Ficus benghalensis* L.	Moraceae
9	Bel	*Aegle marmelos* (L.) Corrêa	Rutaceae
10	Ber	*Ziziphus jujuba* Mill.	Rhamnaceae
11	Ber	*Ziziphus oenopolia* (L.) Mill.	Rhamnaceae
12	Bhirra	*Chloroxylon swietenia* DC.	Rutacea
13	Bija sal	*Pterocarpus marsupium* Roxb.	Fabaceae
14	Bottle Brush	*Callistemon citrinus* (Curtis) Skeels	Myrtaceae
15	Bottle Palm	*Roystonea regia* (Kunth) O.F.Co	Arecaceae
16	Chandan	*Santalum album* L.	Santalaceae
17	Chir	*Pinus roxburghii* Sarg.	Pinaceae
18	Christhmas tree	*Euphorbia pulcherrima* Willd. ex Koltzsch	Euphorbiaceae
19	Copper pod	*Peltophorum pterocarpum* (DC.) K.Heyne	Leguminosae
20	Dikamali	*Gardenia gummifera* L.f.	Rubiaceae
21	Eucalyptus Safeda	*Eucalyptus camaldulensis* Dehnh.	Myrtaceae
22	Eucalyptus Safeda	*Eucalyptus tereticornis* Sm.	Myrtaceae
23	Gulmohar	*Delonix regia* (Hook.) Raf.	Caesalpiniaceae
24	Harsingar	*Nyctanthes arbor-tristis* L.	Oleaceae
25	Imli	*Tamarindus indica* L.	Leguminosae
26	Jangli Jalebi	*Pithecellobium dulce* (Roxb.) Benth.	Leguminosae
27	Kachnar	*Bauhinia variegata* L.	Leguminosae
28	Kadhai	*Anogeissus pendula* Edgew.	Combretaceae
29	Kadi patta	*Murraya koenigii* (L.) Spreng.	Rutaceae
30	Kalp vriksh	*Adansonia digitata* L.	Bombacaceae

S. No.	Common Name	Scientific Name	Family
31	Karanj	*Pongamia pinnata* (L.) Pierre	Leguminosae
32	Karra	*Cleistanthus collinus* (Roxb.) Benth. Ex Hook. F	Euphorbiaceae
33	Kasai	*Bridelia retusa* (L.) A.Juss.	Phyllanthaceae
34	Kathal	*Artocarpus heterophyllus* Lam.	Moraceae
35	Khair	*Acacia catechu* (L.f.) Willd.	Leguminosae
36	Khajur	*Phoenix sylvestris* (L.) Roxb.	Arecaceae
37	Khamer	*Gmelina arborea* Roxb.	Lamiaceae
38	Linaloe	*Bursera paniculata* Lam.	Burseraceae
39	Mahua	*Madhuca longifolia* (J.König ex L.) J.F.Macbr.	Sapotaceae
40	Morpankhi	*Thuja occidentalis* L.	Cupressaceae
41	Moyan	*Lannea coromandelica* (Houtt.) M	Anacardiaceae
42	Munga, Sahjan	*Moringa pterygosperma* Gaertn.	Moringaceae
43	Neem	*Azadirachta indica* A.Juss.	Meliaceae
44	Palas	*Butea monosperma* (Lam.) Taub.	Leguminosae
45	Peela Kaner	*Cascabela thevetia* (L.) Lippold	Apocynaceae
46	Pipal	*Ficus religiosa* L.	Moraceae
47	Poplar	*Populus deltoides* W. Bartram ex Marshall	Salicaceae
48	Rubber plant	*Ficus elastica* Roxb. ex Hornem.	Moraceae
49	Saja	*Terminalia tomentosa* (Roxb.) Wight & Arn.	Combretaceae
50	Salai	*Boswellia serrata* Roxb. ex Coleb	Burseraceae
51	Semal	*Bombax ceiba* L.	Malvaceae
52	Shahtoot	*Morus alba* L.	Moraceae
53	Shisham	*Dalbergia latifolia* Roxb.	Fabaceae
54	Sindurya	*Bixa orellana* L.	Bixaceae
55	Silver Oak	*Grevillea robusta* A.Cunn. ex R.Br.	Proteaceae
56	Sissoo	*Dalbergia sissoo* DC.	Fabaceae
57	Sitaphal	*Annona squamosa* L.	Annonaceae
58	Teak	*Tectona grandis* L.f.	Lamiaceae
59	Tendu	*Diospyros melanoxylon* Roxb.	Ebenaceae
60	Vilayati Jhau	*Casuarina equisetifolia* L.	Casuarinaceae
61	Vilayati Kikar	*Parkinsonia aculeata* L.	Leguminosae
62	Watahlla	*Cassia surattensis* Burm.f.	Caesalpiniaceae
63	Wattle Tree	*Acacia auriculiformis* A.Cunn. ex Benth.	Leguminosae

S. No.	Common Name	Scientific Name	Family
Shrubs and under shrubs (25 sps)			
1	Anantmul	*Hemidesmus indicus* (L.) R. Br. Ex Schult.	Apocynaceae
2	Anar	*Punica granatum* L.	Lythraceae
3	Arhar	*Cajanus cajan* (L.) Millsp.	Leguminosae
4	Bachita	*Urena lobata* L.	Malvaceae
5	Baigan	*Solanum melongena* L.	Solanaceae
6	Bariara	*Sida acuta* Burm.f.	Malvaceae
7	Boganvel	*Bougainvillea spectabilis* Willd.	Nyctaginaceae
8	Chandni	*Tabernaemontana divaricata* (L.) R.Br. ex Roem. & Schult.	Apocynaceae
9	Datura	*Datura metel* L.	Solanaceae
10	Dhawai	*Woodfordia fruticosa* (L.) Kurz	Lythraceae
11	Gulab	*Rosa indica* L.	Rosaceae
12	Gurhal	*Hibiscus rosa-sinensis* L.	Malvaceae
13	Kaner	*Nerium oleander* L.	Apocynaceae
14	Kanghi	*Abutilon indicum* (L.) Sweet	Malvaceae
15	Kapas	*Gossypium arboreum* L.	Malvaceae
16	Karonda	*Carissa spinarum* L.	Apocynaceae
17	Keokand	*Costus speciosus* (Koen.)Retz	Costaceae
18	Madar	*Calotropis procera* (Aiton) Dryand.	Asclepiadaceae
19	Mehndi	*Lawsonia inermis* L.	Lythraceae
20	Milk-Bush	*Euphorbia tirucalli* L.	Euphorbiaceae
21	Rat ki Rani	*Cestrum nocturnum* L.	Solanaceae
22	Salparni	*Desmodium gangeticum* (L.) DC.	Fabaceae
23	Sanai	*Crotalaria juncea* L.	Fabaceae
24	Tulsi	*Ocimum tenuiflorum* L.	Lamiaceae
25	Vilayati Mehndi	*Dodonaea viscosa* Jacq.	Sapindaceae
Herbs (34 sps)			
1	Amarbel	*Cuscuta reflexa* L.	Convolvulaceae
2	Atibala	*Sida rhombifolia* L.	Malvaceae
3	Bada charonta	*Cassia occidentalis* L.	Caesalpiniaceae
4	Badi dudhi	*Euphorbia hirta* L.	Euphorbiaceae
5	Badi dudhi	*Euphorbia hispida* Boiss.	Euphorbiaceae
6	Bariyari	*Sida cordifolia* L.	Malvaceae
7	Bathua	*Chenopodium album* L.	Chenopodiaceae
8	Bhui aonla	*Phyllanthus amarus* Schumach. & Thonn.	Phyllanthaceae
9	Bhui aonla	*Phyllanthus fraternus* Webster	Phyllanthaceae
10	Bhui aonla	*Phyllanthus urinaria* L.	Phyllanthaceae

S. No.	Common Name	Scientific Name	Family
11	Bhui aonla	*Phyllanthus virgatus* G.Forst.	Phyllanthaceae
12	Charota	*Senna insularis* (Britton & Rose)H.S. Irwin & Boss.	Caesalpiniaceae
13	Charota	*Senna tora* L.	Caesalpiniaceae
14	Chauli	*Alysicarpus vaginalis* (L.) DC.	Fabaceae
15	Chhota gokhuru	*Xanthium strumarium* L.	Asteraceae
16	Choti dudhi	*Euphorbia thymifolia* L.	Euphorbiaceae
17	Congress Ghans	*Parthenium hysterophorus* L.	Asteraceae
18	Dudhiya	*Blepharis maderaspatensis* (L.) B.Heyne ex Roth	Acanthaceae
19	Jangli bhindi	*Abelmoschus ficulneus* L.	Malvaceae
20	Jangli methi	*Medicago denticulata* Willd.	Fabaceae
21	Jangli matar	*Vica sativa* L.	Fabaceae
22	Kali musli	*Curculigo orchioides* Gaertn.	Hypoxidaceae
23	Kalmegh	*Andrographis paniculata* (Burm.f.) Nees	Acanthaceae
24	Kharmor	*Rungia parviflora* Nees	Acanthaceae
25	Kharmor	*Rungia pectinata* (L.) Nees	Acanthaceae
26	Lajvanti	*Mimosa pudica* L.	Mimosaceae
27	Latkan	*Triumfetta pentandra* A.Rich.	Tiliaceae
28	Makoy	*Solanum nigrum* L.	Malvaceae
29	Safed musli	*Chlorophytum tuberosum* Baker	Liliaceae
30	Shankhpushpi	*Convolvulus microphyllus* Sieber ex Spreng.	Convolvulaceae
31	Shepherds Purse	*Capsella bursa-pastoris* L.	Brassiacaceae
32	Van moong	*Vigna trilobata* (L.) Verdc.	Fabaceae
33	Van tulsi	*Anisomeles indica* (L.) Kuntze	Lamiaceae
34	Van tulsi	*Hyptis suaveolens* (L.) Poit.	Lamiaceae
Climbers and Creepers (10 sps)			
1	Agla bel	*Acacia pennata* (L.) Willd.	Mimosaceae
2	Gudvel	*Tinospora cordifolia* (Willd.) Miers	Menispermaceae
3	Hiransinghi	*Pergularia daemia* (Forssk.) Chiov.	Apocynaceae
4	Jangli angur	*Cayratia auriculata* (Roxb.) Gamble	Vitaceae
5	Kalihari	*Gloriosa superba* Linn.	Liliaceae
6	Kunduru	*Coccinia grandis* (L.) Voigt	Cucurbitaceae
7	Ram datun	*Smilax macrophylla* Poepp. ex A.DC.	Smilacaceae
8	Ramchana	*Vitis trifolia* Linn.	Vitaceae
9	Satawar	*Asparagus racemosus* Willd.	Asparagaceae
10	Shivalingi	*Bryonopsis laciniosa* (L.) Naudin	Cucurbitaceae

S. No.	Common Name	Scientific Name	Family
Grasses (17 sps)			
1	Dub Grass	*Cynodon dactylon* (L.) Pers.	Poaceae
2	Coco Grass	*Cyperus rotundus* L.	Cyperaceae
3	Slender Cyperus	*Cyperus distans* L.	Cyperaceae
4	Rice Sedge	*Cyperus difformis* L.	Cyperaceae
5	Annual Sedge	*Cyperus compressus* L.	Cyperaceae
6	Rice Flatsedge	*Cyperus iria* L.	Cyperaceae
7	Shortleaf Spikesedge	*Kyllinga brevifolia* Rottb.	Cyperaceae
8	Whitehead Spikesedge	*Kyllinga nemoralis* Dandy ex Hutch. & Dalz.	Cyperaceae
9	Egyptian Crowfoot Grass	*Dactyloctenium aegyptium* (L.) P. Beauv.	Poaceae
10	Blue Panicgrass	*Panicum antidotale* Retz.	Poaceae
11	Johnson Grass	*Sorghum halepense* (L.) Pers.	Poaceae
12	Yellow Bluestem	*Bothriochloa ischaemum (*L.)	Poaceae
13	Common Wild Oat	*Avena fatua* L.	Poaceae
14	Crimson Fountaingrass	*Pennisetum setaceum* (Forsk.) Chiov	Poaceae
15	Guli Danda	*Phalaris minor* Retz.	Poaceae
16	Poison Darnel	*Lolium temulentum* L.	Poaceae
17	English Ryegrass	*Lolium perenne* L.	Poaceae

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INFLUENCE OF BIOFERTILIZERS AND FERTILIZERS ON VEGETATIVE AND REPRODUCTIVE CHARACTERISTICS OF MARIGOLD (TAGETS TENUIFOLIA L.) CV. GOLDEN LOCAL.

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ABSTRACT

To study the influence of organic and inorganic on quality and yield components in OF Marigold (tagets tenuifolia L.) cv. Golden Local to boost the productivity potential combined application microbial and chemical fertilizers had a great influence at all the growth stages of the crop. Significant differences in all parameters like, plant height, number of leaves, leaf area and number of branches due to the combined application of microbial fertilizer and chemical fertilizer. Maximum plant height (55.23 cm) was observed in Treatment-5 containing NPK+ Phosphobacteria (each 7g / pot). The maximum number of flowers (37.25) per plant was produced in T5 treatment and the maximum number of flower s (27.25/plant). The highest number of branches per plant (26.25) was recorded in treatment T5. Highest flower weight was observed in T5 was (112.23g) Total number of leaf observed 185.33 per plant was observed in T-5, and leaf area fairly gives a good idea of photosynthetic capacity of the plant. Significant differences were noticed with regard to leaf area index among the treatments at all growth stages.

Keywords : *DAP, NPK, urea azospirillum, phosphobacteria, chemical fertilizer and marigold.*

INTRODUCTION

Marigold (*tagets tenuifolia* L.) cv. Golden Local is well responsive to nutrition and found to have great variability with varieties ,climatic conditions and soil fertility. It,s moderate feeder trait may be utilize to maximize productivity. It belongs to family COMPOSITEAE . Plant is herbaceous, annual with erect or compact in habit. It behaves like a herb. It is popular flower. It can be grown throughout the year in almost all the states of India except at higher altitudes. The important growing countries in the world are

India, Bangladesh, Pakistan, China, Cyprus, Egypt, Japan, (Anon 2001). In India, major producing states are , Bihar, Karnataka, West Bengal, Andhra Pradesh, Maharashtra and Uttar Pradesh (Anonymous, 2004). The varieties show a wide range of flower colour ranging from white, yellow, red with varying shades . It is quite high in aesthetic value and can be well compared with any flower . Farmers may boost-up their socio-economic status by growing it if assured and remunerative yield obtained from this crop.

MATERIALS AND METHODS

The experiment was carried out in a Completely Randomized Block each unit Design (CRBD) at the Department of Horticulture, Kulbhasker Ashram Post Graduate College ,Allahabad during the year 2018-19. The mechanical compositions, physical and chemical

properties of experimental soil, which was used for pot culture study. The soil physical and chemical properties such as pH, Nitrogen (Jackson, 1958), Phosphorus (Jackson, 1958) and potassium (Peach and Tracey,1956) contents were analyzed. The raised seed bed of 3x1.5m size was prepared,and marigold seeds were sown in one centimeter depth in the rows spaced at 7 cm and covered with thin layer of FYM. 25days seedlings were transplanted to the trial pot. The treatments, were T-1 DAP+ Azospirillum (7g / pot),T-2 DAP+Phosphobacteria (7g / pot), T-3 DAP+Potassium mobilizer (7g / pot),T-4 NPK Mixture +Azospirillum (10g /pot), T-5 NPK mixture +Phosphobacteria (7g / pot), T-6 NPK mixture +Potassium mobilizer (7g / pot), T-7 Urea+ Azospirillum (each 7g /pot), T-8 Urea+ Phosphobacteria (each 7g / pot), T-9 Urea+ Potassium mobilize (7g / pot), T-10 Urea (Control). (each 7g / pot) . Five plants were selected randomly from plot to record yield contributing characters. All practical managements included; mulching, weeding and other agronomic treatments were done mechanically. Irrigation was done based on plant requirements. In maturity time, flower yield, number of flower per plant, total plant height, shoot length, root length, number of branches per plant, number of leaves and leaf area per plant were measured. The collected data were analyzed statistically by F-test to examine the treatment effects and the mean differences were adjudged by Duncans Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

The present study was observed that the application of microbial and chemical fertilizers combined application had a great influence at all the growth stages of the crop. Significant differences in all parameters like, plant height, number of leaves, leaf area and number of branches due to the combined application of microbial fertilizer and chemical fertilizer. Maximum plant height (55.23cm) were observed in T5 (Table1). The data on shoot length (31.25cm), and root length (41.25cm) as influenced by the combination of biofertilizers and chemical fertilizers showed significant differences among the treatments at all the stages. The highest number of branches per plant (26.25nos) was recorded in treatment T5 . Highest flower weight was observed in T5 (112.23g) Total number of leaf observed 185.33 per plant was observed in T-5,and leaf area fairly gives a good idea of photosynthetic capacity of the plant. Significant differences were noticed with regard to leaf area index among the treatments at all growth stages. The treatment 5 showed significantly higher leaf area (1720.23 cm2).The increase in leaf area index could be attributed to increased cell division and elongation resulting in increased leaf expansion, more number of leaves due to beneficial influence of biofertilizers which release growth promoting substances and enhances the availability of nitrogen. From the data it appeared that flowering of marigold were positively influenced by sources of nutrients applied. The maximum number of flowers (37.25/plant) per plant was produced in T5 treatment and the maximum number of flowers (18.33/plant).Similar results were also reported by Naidu et al., (1999) revealed that the morphological parameters were affected significantly due to the application of different combination of organics, chemicals and biofertilizers.Nitrogen fertilizer use has played a significant role in increase of crop yield (Modhej et al., 2008). Significant increase in plant height, number of leaves, number of branches and number of flowers due to influenced by environmental conditions and management practices. Prabhu et al., (2003) their studies indicated that plant height is increased by the

application of organics and biofertilizers, attributed to the increased uptake of nutrients in the plants leading to enhanced chlorophyll content and carbohydrate synthesis and increased activity of hormones produced by *Azospirillum* and phosphate solubilizing bacteria.The Phosphobacteria increased phosphate availability in soils which in turn helped better proliferation of root growth and uptake of other nutrients to the greater extent. So that the enlargement in cell size and cell division, which might have helped in plant height, number of leaves, branches number of flowers per plant. These results are in agreement with those reports of Nanthakumar and Veeraraghavathatham(2000), Anburani and Manivannan (2002),and Wange and Kale (2004). Fundamentally, K+ is very water soluble and highly mobile and transported in the plants xylem (Lack and Evans, 2005). Membrane transport of potassium can be mediates either by potassium channels, utilizing the membrane potential to facilitate transport of potassium down its electrochemical gradient,or by secondary transporters . In plants,potassium act as regulator since it is constituent of 60 different enzyme systems of drought tolerance and water-use efficiency. In addition, current study has showed that to optimum growth, crops need more potassium than needed (Simonsson et al., 2007)Aminifard et al., (2010) with study responses of eggplant to different rates of nitrogen under field conditions were reported that fertilization with 100 Kg/ha nitrogen resulted in the highest average fruit weight and fruit yield. Pal et al., (2002) were reported that eggplant fruit yield increased with increase in nitrogen up to187.5 kg/ha. Only microbial treated plants could not increase the vegetative growth of plants and the reason may be that they released nutrients at a slower rate. On the other hand,the only application of inorganic fertilizer was also less effective than the combined application. These results were inconformity with the findings of Rahman etal. (1998) found that the vegetative growth and yield of berry was the highest with the combined application of manures andfertilizers. For Daisy , the integrated use of urea and poultry manure also resulted in a higher nutrient uptake Jose et al., (1988).The use of synthetic fertilizers causes a great impact on the environment and the cost of these fertilizers is increasing over the years.The farmers need to raise the crops by organic farming that will reduce the costs and will decrease the impact on the environment.

In addition, organic farming will reduce the additional burden of environmental pollution that is caused while manufacturing these synthetic fertilizers at the source (Rathier and Frink, 1989). Now it is a well established fact that organic fertilizers provide enough requirements for proper growth of the crop plant and may enhance the uptake of nutrients, increase the assimilation capacity and will stimulate the hormonal activity as well (Tomati et al., 1990). The use of biofertilizers useful as it increases soil porosity, aeration and water holding capacity, therefore a practically paying proposal. Azospirillum, a nitrogen fixing organism has been reported to be beneficial and economical on several crops. They improve the growth and yield as well as productivity of the crop. Vanangamudi et al., (1989) also reported similar increase in per cent germination and shoot length with increase in nitrogen application (0 150 kg/ha). Prabhu et al. (2003) reported that increased N and P rates increased the plant height, branch number per plant phosphate solubilizing Bacteria (PSB) are a group of beneficial bacteria capable of hydrolysing organic and inorganic phosphorus from insoluble compounds. Chen et al., (2006) P-solubilization ability of the microorganisms is considered to be one

of the most important traits associated with plant phosphate nutrition P-solubilizers are biofertilizers which solubilizes the fixed phosphorus in soil and makes it available for plants. The microbes, *Fraturia aurantia* belonging to the family *Pseudomonaceae*, is a beneficial bacteria capable of mobilizing potash to plants in all types of soil especially, low K Content soil. Such bacterial population in the soil form can increase the availability of potash to the plants. Wange and Kale (2004) reported that, the results revealed significant improvement in vegetative characters such as plant height and number of leaves per plant over the recommended biofertilizer with combine chemical fertilizer. The information on the role of organics on morphophysiological traits is meager. Hence, there is a need to study the influence of organic and inorganic on quality and yield components marigold to boost the productivity potential.

The cost of inorganic fertilizers has been enormously increasing to an extent that they are out of reach of the poor, small and marginal farmers. It has become impractical to apply such costly inputs for a crop of marginal returns. The use of biofertilizers in such situation is therefore a practically paying proposal. Based on the above results, it was concluded that, the application of microbial and chemical fertilizers was found more beneficial and significantly improved morpho-physiological traits, growth parameters, and yield components in daisy. The benefit cost ratio was found lesser in using both biofertilizer and chemical fertilizer compared to using chemical fertilizer alone in daisy crop cultivation.

Table - 1 : The effect of microbial and chemical fertilizer on vegetative characteristics of marigold (*tagets tenuifolia* L.) cv. Golden Local. plant.

Treatments	Plant height(cm)	Shoot length (cm)	Shoot /plant(no)	Leaves/plant (cm)	Leaf area/plant (cm2)	Root/plant (no)	Root length (cm)
T_1	40.11	15.01	12.21	120.12	1110.21	11.20	20.25
T_2	42.33	17.41	14.24	142.01	1320.25	13.22	22.22
T_3	41.12	16.01	13.21	130.11	1201.22	12.02	21.02
T_4	52.21	27.01	23.10	162.21	1500.20	22.23	42.36
T_5	55.23	31.25	26.25	185.33	1720.23	25.14	45.65
T_6	51.51	28.41	24.00	154.00	1445.01	23.02	41.25
T_7	35.44	25.00	9.25	95.33	950.23	8.35	25.36
T_8	38.25	26.02	10.23	100.23	1000.25	9.36	28.44
T_9	36.21	24.22	9.89	96.65	960.56	8.55	26.25
T_{10}	26.23	10.64	5.54	55.65	565.85	4.56	15.68
MSE+_	7.25	3.22	2.14	12.02	45.36	1.20	2.36

Table - 2 : The effect of microbial and chemical fertilizer on reproductive characteristics of Marigold (*tagets tenuifolia* L.) cv. Golden Local.

Treatments	Anthesis time (DAP)	bud/plant (no)	Flower opening/plant (no)	Full bloom /plant (no)	Single Flower weight (g)	Flower yield/plant (kg)	Flower yield (Q/ha)
T_1	70.11	21.01	13.21	10.12	50.21	0.800	230.25
T_2	72.33	23.41	15.24	142.01	72.25	1.0	232.22
T_3	71.12	22.01	14.21	13.11	60.22	0.900	231.02
T_4	66.21	33.01	24.10	16.21	90.20	0.930	452.36
T_5	65.23	37.25	27.25	18.33	92.23	2.240	455.65
T_6	66.51	34.41	25.00	15.00	104.01	2.0	451.25
T_7	75.44	31.00	10.25	9.33	85.23	0.530	235.36
T_8	78.25	32.02	11.23	10.23	90.25	0.630	238.44
T_9	76.21	30.22	10.89	9.65	26.56	0.550	236.25
T_{10}	96.23	16.64	6.54	5.65	6.85	0.156	125.68
MSE+_	9.25	5.22	3.14	1.02	3.36	0.120	23.36

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EFFECT OF AM FUNGI, PSB, RHIZOBIUM AND CHEMICAL FERTILIZERS ON GROWTH AND YIELD OF PEA (PISUM SATIVUM)

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ABSTRACT

The present investigation was undertaken to Effect of AM fungi, PSB, Rhizobium and chemical fertilizers on growth and yield of Pea (Pisum sativum).Three important bio–inoculants viz., AMF, Rhizobium and PSB were utilized in the study. A mixture of mycorrhiza, consisting of equal amount of two common AMF species namely, Acaulospora scrobiculata Trappe and Glomus intraradices schenck and smith were used as AMF representatives. All Bio inoculants increased plant height significantly.

Keywords : *Bio-inoculants, AMF, rhizobium and PSB.*

INTRODUCTION

Pulses are major sources of (22-24%) among the vegetarians in India, and complement the staple cereals in the diets with proteins, essential amino Acids, vitamins and minerals (Deaker *et al*.2004). These can restore soil fertility through biological nitrogen (N) fixation and can also improve physical soil properties with their deep root systems (Singh and Saxena 1996).

Pea crop contain protein 22%, carbohydrate 60%, fat 1.8%, sugar 12%, amino acids, calcium, phosphorus, and small quality of iron. Peas are high in vitamin A, vitamin C, vitamin B, and lutein. Dry weight is about one-quarter protein and one-quarter sugar. Pea seed peptide fractions have less ability to scavenge free radicals than glutathione, but a greater ability to chelate metals and inhibit linoleic acid oxidation.These can restore soil fertility properties with their deep root systems (Singh and Saxena 1996).

Pea are important pulse crops of central India, which is often grown on marginal lands and are generally supplied with sub-optimal doses of fertilizers in local varieties leading to low productivity of the crops.

Modern agriculture depends on the application of fossil fuel-based inputs like chemical fertilizers, pesticides and herbicides (Singh*et al*. 2011). There is growing awareness and concern over their adverse effects on soil productivity and environmental quality. The high cost of fertilizers, the low purchasing power of small and marginal farmers and their adverse effects on environment has led to search for some alternative strategies (Adesemoye and Kloepper 2009). One such approach is the use of different integrated nutrient management system, which can save soil, environment and farmers limited resources. Inoculation of pulses with arbascular mycorrhizal fungi (*AMF*), *Rhizobium* and phosphate solubilizing

bacteria (*PSB*) causes growth stimulation of plant and enhances crop yields (Lupwayi and Kennedy 2007; Vikram and Hamzehzarghani 2008).

Present study, conducted at Institute of Agricultural Sciences Bundelkhand University, Jhansi attempt were made to estimate the potential saving of DAP on account of inoculations of Pea with AMF, Rhizobium and PSB.

Therefore, the present investigation was undertaken to Effect of *AM fungi, PSB, Rhizobium* and chemical fertilizers on growth parameter and yield of Pea (*Pisum sativum*).

MATERIALS AND METHODS

Seed of Pea Vikash procured from Indian institute of pulses Research, Kanpur, were used in present study. These were surface sterilized with 0.01% (w/v) $HgCl_2$ and washed several time (four to five) with distilled water remove any trace of chemical; then, germinated on water agar (8 g L^{-1} w/v) in Petri dishes at 30°C.

Three important bio–inoculants viz., *AMF*, *Rhizobium* and *PSB* were utilized in the study. A mixture of mycorrhiza, consisting of equal amount of two common *AMF* species namely, *Acaulospora scrobiculata* Trappe and *Glomus intraradices* schenck and smith were used as *AMF* representatives. The above-mentioned species were procured NRCAF, Jhansi. Liquid cultures of *Rhizobium* (rhizoteeka) specific for Pea and *PSB* (phosphoteeka) were procured from Chaudhari Charan singh Haryana Agricultural University, Hissar.

Experimental trial

To estimate the potential saving of chemical fertilizer (Di- ammonium phosphate; DAP) on account of inoculation of gram with important bio-inoculants, study was conducted at natural condition the trial consisted of DAP (recommended doses of DAP) and two bio – inoculants based treatment i.e. with (DAP+ *AMF*+*Rhizobium* + *PSB*) and without (only DAP) application of bio-inoculants. Thus, a total of eight treatments were employed in the study, which were as follows:

1- DAP
2- DAP+*AMF*
3- DAP+Rhizobium
4- DAP+*PSB*
5- DAP+*AMF*+*Rhizobium*
6- DAP+ *AMF* + *PSB*
7- DAP+*Rhizobium*+*PSB*
8- DAP+ *AMF*+ *Rhizobium*+*PSB*

All the treatmentswere replicated three times. Thus, a total of 24 pots 7-8 kg capacity (36x24 cm) were maintained under natural conditions. Pots filled with unsterilized black soil (vertisol) were used. DAP were applied in respective pots. In bio-inoculants based treatment, 50g *AMF* inoculum was applied 4-5 inches below the seed treated with *Rhizobium* and *PSB*. For the treatment of seeds with bio-inoculants (*Rhizobium* and *PSB*), 50g jaggery was taken in 200 ml distilled water, boiled and a solution was prepared.~ 100g seeds of pea were taken in two separate sterilized conical flasks and solution was added to ensure the coating; then, 0.5ml inocula of *Rhizobium* and *PSB* were applied to the 100g jaggery coated seeds. Treated seeds were dried in shade and were utilized for sowing. On the other hand, in un–inoculated pots, surface sterilized seeds were sown. Pots were watered as and when required. At the time of harvesting, observation on growth parameters [plant height (cm) and dry weight (g plant)]$^{-1}$, yield related parameters [number of pods plant^{-1} and yield (g plant) $^{-1}$], number of nodules and colonization index by *AMF* were recorded.

For assessment of root colonization index, approximately 1g fresh fine roots were collected at the time of harvesting and were stained as per

procedure given below:

***Procedure*:** Clearing and staining of root specimens was done by using the method of Kormanik *et al*. (1980). Root samples were washed under running tap water thoroughly, placed in glass vials containing 10% KOH solution and heated at 90°C for about 1 hour. The KOH solution clears the host cytoplasm and nuclei and readily allows stain penetration. After heating, KOH solution was poured off and the root Samples were washed using at least three to four complete changes of tap water or until no brown colour appeared in the rinse water. Washed roots were placed in alkaline H_2O_2 at room temperature for 1 hour or until roots were bleached. Then the roots were washed with tap water thoroughly using three to four changes. The alkaline H_2O_2 solution was made as per need as it loses its effectiveness on storage.

After H_2O_2 treatment, the samples were treated with 1.0% HCI for 30 minutes and then the solution was poured off. The roots were not rinsed with water after this step because these must remain acidified for proper staining. The root sample were kept in 0.05% staining solution (Trypan blue) after HCL treatment and kept at 90°C for 1 hour. After removing staining solution, the root specimens were placed in de-staining solution for mycorrhizal assay. The specimens were not washed with after staining because the stain is readily removed from the fungal structure. The de-staining solution was the standard staining solution as mentioned about, without the stain.

Mycorrhizal assay: Root segment, each approximately 1 cm long were selected at random from stained samples and mounted on microscopic slides in groups of 10.Twenty root segments from each sample were used for assessing length of corticalColonization in millimeters, at 40X. Then, colonization index in cleared root parts was determined with a microscope (Nikon Eclipse E 400) at ×40 using gridline intersect method of Giovannetti and Mosse (1980).

RESULTS AND DISCUSSION

Present study was conducted to estimate the effect of inoculation of important bio-inoculants, namely arbascular mycorrhizal fungi (*AMF*), *Rhizobium* and phosphate solubilizing bacteria (*PSB*) with phosphatic fertilizer i.e. Di-ammonium phosphate (DAP) fertilizer on growth and yield in *Pisum sativum*.

All Bio inoculants increased plant height significantly. Maximum plant height was recorded in Maximum plant height was recorded in DAP + *AMF* + *Rhizobium* + *PSB* followed by DAP + *Rhizobium* + *PSB*, DAP + *Rhizobium*, DAP + *AMF*, DAP + *PSB*, DAP + *AMF* + *Rhizobium* which were significantly higher as compared to un- inoculated pots with DAP. DAP + *AMF* +*PSB*were at par with control.

All inoculants were significant in Plant Dry Weight. Maximum Dry Weight per plant was recorded in DAP + *AMF* + *Rhizobium* + *PSB* followed by DAP + *Rhizobium* + *PSB*, DAP + *Rhizobium*, DAP + *AMF*, DAP + *PSB*, DAP + *AMF* + *Rhizobium* and DAP + *AMF* +*PSB* as compared to un- inoculated pots with DAP.

Application of chemical (micro nutrients) as well as microbes (*Rhizobium* and *PSB*) significantly increased dry biomass of Bengal-gram (Gupat and Sahu 2012).

Maximum number of pod was recorded in DAP + *AMF* + *Rhizobium* + *PSB* followed by DAP + *Rhizobium* + *PSB*, DAP + *Rhizobium*, DAP + *AMF*, DAP + *PSB* which were significantly higher as compared to un- inoculated pots with DAP, DAP + *AMF* + *Rhizobium* and DAP + *AMF* +*PSB* was at par with control.

Maximum yield per plant was recorded in

DAP + *AMF* + *Rhizobium* + *PSB* followed by DAP + *Rhizobium* + *PSB*, DAP + *Rhizobium*, DAP + *AMF*, DAP + *PSB*, DAP + *AMF* + *Rhizobium* which were significantly higher as compared to un-inoculated pots with DAP. DAP + *AMF* +*PSB* was at par with control.

Table - 1 : Effect of application of Bio-fertilizers with chemical fertilizer on plant height, number of pod, Yield,Number of nodules, Dry weight plant and Colonization index of *Pisum sativum:*

TREATMENT	PLANT HEIGHT (cm.)	NUBER OF POD	YIELD (gm.)	NUMBER OF NODULES	DRY PLANT WEIGHT (gm.)	COLONIZATION INDEX
DAP(Uninrulation)	12.6	4.6	7.0	5.00	1.4	5.13
DAP+arbuscular mycorrhiza	17.6	7.6	20.6	24.00	3.0	23.08
DAP+Rhizobium	19.0	9.3	22.6	24.66	3.5	8.60
DAP+PSB	16.3	6.6	17.0	23.00	2.6	7.86
DAP+Arbuscular mycorrhiza+Rhizobium	15.5	6.0	13.0	19.00	2.2	9.16
DAP+Arbuscular mycorrhiza+PSB	13.3	5.3	7.6	15.66	1.6	20.20
DAP+Rhizobium+PSB	21.3	13.0	25.3	26.66	4.1	8.67
DAP+Arbuscular mycorrhiza+Rhizobium+PSB	23.5	14.3	28.0	27.33	4.8	22.50
LSD(0.05%)	0.843	1.368	2.955	8.58	0.337	6.83
S Em	0.281	0.456	0.986	2.97	0.112	2.36

Babajide *et al*. (2008) studied the effect of *Glomus clarum* and different *Rhizobial* strains, under low fertile eroded soil condition. Plant growth and yields were significantly enhanced with *AMF* Inoculation. However, co-inoculation of *AMF* with any of *Rhizobial* stains further Improved the growth and biomass. Similar results have also been recorded with Pea and faba bean (Geneva et al. 2006; Xavier and Germida 2002).

The studies on interactive effects of *AMF*, *Rhizobium* and *P-solubilizers* on growth and yield of pulse crops and their integration with chemical fertilizers, are scarce. In a pot experiment, Poi *et al*. (1989) observed the singnificantly higher dry matter production and nutrient uptake by Bengal-gram after simultaneous inoculation of *Glomus fasciculatum*, *Rhizobium and Bacillus polymyxa*.

All Bio inoculants increased number of nodules per plant significantly. Maximum number of nodule per plant was recorded in DAP + *AMF*+ *Rhizobium* + *PSB*, followed by DAP + *Rhizobium* + *PSB*, DAP + *Rhizobium*, DAP + *AMF*, DAP + *PSB*, DAP + *AMF* + *Rhizobium*, and DAP + *AMF* +*PSB* as compared to un- inoculated pots with DAP.

Tomer and kumar (2001) investigated the effects of these bio-inoculants with or without P

fertilizer on yield of black gram. Application of P enhanced nodulation, yield, and N and P content of plant.

Maximum colonization index was recorded in DAP + *AMF*, DAP + *AMF* + *Rhizobium* + *PSB*, DAP + *AMF* +*PSB* which were significantly higher as compared to un- inoculated pots. DAP + *AMF* + *Rhizobium*, DAP + *Rhizobium* + *PSB*, DAP + *Rhizobium* and DAP + *PSB* was at par with control.

Results revealed that application of bio-fertilizers (*AM fungi, Rhizobium* and *PSB*) significantly increased the growth and yield related parameters in test crops chickpea. Such improvement in overall growth of studied crops was due to the additive effects of above mentioned microorganisms, which might have supplied a more balanced nutrition (nitrogen by *Rhizobium* and P by *PSB* and *AM* fungi) to the plants or improved nutrient absorption. Higher colonization index was reported in biofertilizer inoculated plants. The explanation of this is that mycorrhizal endophyte could be stimulated in quantity and longevity by metabolic products released from *PSB*. Moreover, root exudation might have been changed by *PSB* inoculation, which could also affect *AM* development (Poi *et al*. 1989; Zaidi and Khan 2006; Avis *et al*. 2008). As per our results, per cent increase in bio-fertilizers inoculated chickpea over control.

Use of AMF, Rhizobium and PSB inoculation had also shown advantage over no-inoculation. Thus, Pea inoculation of AMF, Rhizobium and PSB may be recommended to realize higher yield of Pea in this region.

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PRODUCTIVE PERFORMANCE OF GANGATIRI CATTLE IN EASTERN UP

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ABSTRACT

A study was undertaken on performance of Gangatiri cows; the objective was to evaluate the productive performance of Gangatiri cattle in eastern UP at Department of Animal Husbandry and Dairying, SHUATS. The study areas were purposively selected based on the potentiality of Gangatiri cattle. A total of 20 cows were selected. A cross-sectional survey and structured questionnaire were also used for the study. The overall reported milk yield 351 to 1286 liters per lactation (4-7 litters milk /day/cow), fat yield 5.30% (Range-3.6-5.5 %), TS 13.51 (range 12.6 to 14.42),SNF 8.5% (Range 7.9-9.1%), dry period 172 days (from 69 to 265 days), lactation length 295 days (from 194 to 460 days), wet (1.33 to 4.71 litters/day) and herd average 0.22 to 1.95 litters/day were recorded.

Key words: *Gangatiri cattle breed, milk yield, quality of milk, lactation length, dry period, wet and herd average.*

INTRODUCTION

In India, there are about 40 breeds of cattle among this cattle breed Gangatiri is one of the important dual purpose breed of North India. Average daily milk yield of Gangatiri cow ranged between 4-6 liters per day. The lactation length is of 150-250 days. Inter calving period varies between 14-24 month. Coat color of Gangatiri cow is dull white. Muzzle is black, Hump and dewlap are medium. It is known to be originated in the region along the banks of Ganga River in Eastern Uttar Pradesh and Western parts of Bihar state. Gangatiri breed has been recognized as a separate breed by NBAGR-ICAR (Accession no. 03039)

MATERIALS AND METHODS

This study was conducted at Improvement of Gangatiri cows of Department of Animal Husbandry and Dairying, faculty of Agriculture, SHUATS, Prayagraj. Data on milk yield, fat yield, TS, SNF, dry period, lactation length, wet and herd average of three years from 2014 to 2017 were used for the present study. The average values for these parameters were recorded.

Management of animals: The management and feeding practices followed on cattle unit farm is uniform. Gangatiri are given ration according to the feeding schedule. At the time of morning and evening milking concentrates are allowed to each individual cow in accordance of their requirement for maintenance plus production. Dry roughages of wheat straw and the green as per availability (Green maize, Green Jowar and Berseem) are fed to them. Good housing facilities (Tail to Tail system) exist at the farm. Enough health cover is provided to protect

the animals from epidemics and causal incidences of ill- health and eventualities.

RESULTS AND DISCUSSION

Milk Yield:

Milk yield varied from animal to animal from 351 to 1286 litters per lactation as shown in fig.1. 4-7 litters milk /day/cow has been recorded. The yield of milk depends on the mammary gland receiving a continuous supply of various metabolites from the blood. The milk yields of all animals undergo seasonal variation as well as the supply of feeds too. Milk yield in the cattle is relatively unaffected within the temperature range of 0^0–21^0C. AT temperature lower than 5^0C as well as from 21^0–27^0C the decrease in milk yield is more marked. This decline is also observed in high humidity. It has been estimated that milk production decreases approx. 1 kg. for each degree rise in rectal temperature, **Singh, (2001).** The milk yield obtained per lactation from the cows calved during the period from March-2015 to August-2017 are given along with graphical presentation:-

Milk Composition:

In general, the gross composition of Indian cow's milk is (86.26 - 87.07 %) water, (3.96 – 4.50 %) fat, (9.02 – 9.40%) SNF and (13.01 – 13.81%) T.S **(Talukder,et.al. 2013)**. The composition of milk in Gangatiri cattle has been recorded as fat 5.30% (Range-3.6-7.0 %), SNF content 8.5% (Range 7.9-9.1%) and TS 13.51 (range 12.6 to 14.42) which indicates the richness of milk in nutrients.

Dry Period (Days) of Animals:

The dry period ranges from 69 to 265 days and an average of 172 days which is almost same as reported by **Dutt and Desai, 1965**, where it ranges from 106 to 162 days period in farm bred animals' and as long as 571 days in non-farm animals. The average dry period varies widely in indigenous breed. It also depends on whether the animal is kept in the farm or not. The dry period in farm bred animals' ranges from 106 to 162 days, and in non-farm animals as long as 571 days. **(Dutt and Desai, 1965).** The wider dry period reduces economic return in exchange for feed, labor etc. and affects subsequent lactation length, as well as subsequent lactation yield **(Prasad and Pereira, 1986)**. Therefore a dry period of 50-60 days is optimum to provide rest to organs of milk secretion for building up reserve of nutrients, maintaining good level of milk production in subsequent lactation, diverting nutrition for development of fetus, to maintain health and to prevent nutritional deficiency disease like milk fever. The shorter dry period not only reduces level of immunoglobulins in first milk but also adversely affects the persistency of cow in milk in subsequent lactation. Such cows do not maintain high level of milk production and also become prone to nutritional deficiency diseases like milk fever.

Lactation Length (day):

The lactation length of Gangatiri cows ranged from 194days to 460days and an average lactation length of 295 days has been recorded, which is very near to standard lactation length of 300days.The milk yield in lactation depends on persistency as well as lactation period for majority of animals. Shorter lactation length causes poor lactation milk yield while longer lactation will correspondingly enhance milk production. There are conflicting views on whether lactation length is heritable or not, whereas some investigators opined that variation in this trait is mainly due to managerial differences, while some showed that it was heritable. In most of the indigenous cattle lactations are short and determined by many factors, heredity being the main one **(Singh and Desai 1961a; Dadlani, 1969a)**. Since the genetic variability in Indian breeds of cattle is more, there is sufficient scope for selection of the animals for this trait. It is

one among the economic traits which influences the persistency in the total milk production **(Singh and Desai, 1961a).**

Wet and Herd average in milk:

The wet and herd average of Gangatiri cows ranged from 1.33 to 4.71 litters/day and 0.22 to 1.95 litters/day were respectively.

Table - 1 : Highest, lowest and average values of milk produced, dry period and lactation length in Gangatiri cows.

Parameter	Milk Yield(litter)	Dry Period(day)	Lactation length(day)
Highest Value	1286	213	460
Lowest Value	359	69	194
Average Value	**717.375**	**172**	**295**

Table - 2 : Highest, lowest and average values of fat, SNF, TS, wet average and herd average in Gangatiri cows.

Parameter	Fat %	S.N.F. %	T.S.%	Wet Average %	Herd Average %
Height Value	5.5	9.1	14.42	4.71	1.95
Lowest Value	3.6	7.9	12.6	1.33	0.22
Average Value	**5.30**	**8.5**	**13.51**	**3.02**	**1.085**

CONCLUSION

This study indicates that the performance of Gangatiri cows milk yield, fat yield, TS, SNF, dry period, lactation length, wet and herd average are up to mark as per efficiency of the breed. Therefore, additional production strategies like improving environmental factors and managemental factors are needed to improve the production performance.

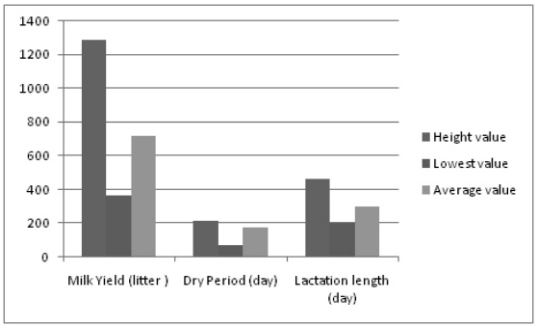

Fig-01 Highest, lowest and average values of milk produced, dry period and lactation length in Gangatiri cows.

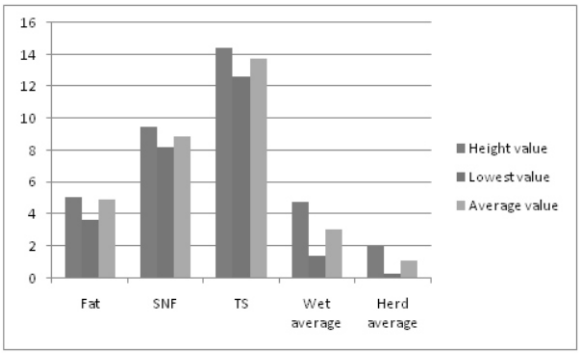

Fig-02 Highest, lowest and average values of fat, SNF, TS, wet average and herd average in Gangatiri cows.

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FAUNAL DIVERSITY OF DUMNA NATURE RESERVE, JABALPUR (MADHYA PRADESH)

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ABSTRACT

In the present study altogether 323 species recorded in, of which 27 mammalian species, 188 avian species, 31 species of reptiles including 16 species of snakes, 8 species of amphibians, 34 species of butterflies and 19 species of dragonflies and damselflies were recorded from Dumna Nature Park is situated in Jabalpur Madhya Pradesh.

Keywords : *Faunal diversity, dumna nature park.*

INTRODUCTION

Dumna Nature Park is situated in Jabalpur Madhya Pradesh. The faunal diversity of the study area includes many species of mammals, reptiles, insects, butterflies, dragonflies as well as spiders. A broad account of avian diversity in the state of Madhya Pradesh and Chhattisgarh was presented by Chandra and Singh (2004). They reported 517 species belonging to 69 families from the areas. Similarly records of birds from Central Highlands of Madhya Pradesh were reported by Jayapal et al. (2005). In 2008, Ghosh *et al.* published a detailed account of avian fauna from the states of Madhya Pradesh (including Chhattisgarh), reporting altogether 449 species. Talmale *et al.,* in 2012 published an account of 173 bird species from Singhori Wildlife Sanctuary (Raisen District), Madhya Pradesh. Dubey *et al*. (2017) reported 56 avian species from Dumna Nature Reserve. Again 46 species of birds from Gun Carriage Factory Estate were recorded by them in same year. Similarly 118 species of birds belonging to 45 families were reported by Dubey *et al.* in 2018 from College of Material Management (CMM), Jabalpur. In similar context, 72 avian species belonging to 30 families were recorded by Bhandari *et al.* in 2018 from Ordnance Factory Khamaria (OFK) Estate.

MATERIAL AND METHODS

In the four years of continuous study of Dumna Nature Reserve, Jabalpur (Madhya Pradesh), was done by the first author, in this survey we studied many animals species in the Nature Park. We used binocular, GPS and Nicon 700 DSLR camera for the study. List was authenticated by various literatures and flied guide.

RESULTS AND DISCUSSION

Overall from faunal perspective total 323 species recorded in this study, of which 27 mammalian species, 188 avian species, 31 species of reptiles including 16 species of snakes, 8 species of amphibians, 34 species of butterflies and 19 species of dragonflies and damselflies were recorded in this study. This study will enhance the faunal diversity data of DNR as well as Jabalpur, Madhya Pradesh.

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List of Faunal Diversity recorded from of Dumna Nature Reserve

Mammals (27 sps)			
1	Leopard	*Panthera pardus fusca* Meyar	Canidae
2	Asian Palm Civet	*Paradoxurus hermaphroditus* (Pallas)	Viverridae
3	Asiatic Jackal	*Canis aureus aureus* Linnaeus	Canidae
4	Bengal Fox	*Vulpes bengalensis* (Shaw)	Canidae
5	Ind, Grey Mongoose	*Herpestes edwardsi nyula* (Hodgson)	Herpestidae
6	Spotted Deer	*Axis axis axis* (Erxleben)	Cervidae
7	Barking Deer	*Muntiacus muntjak* (Zimmermann)	Cervidae
8	Sambar	*Cervus unicolor niger* Blainville	Cervidae
9	Indian Gazelle	*Gazella bennettii* (Sykes)	Bovidae
10	Rhesus Macque	*Macaca mulatta* (Zimmermann)	Cercopothecidae
11	Common Langur	*Semnopithecus entellus* (Dufresne)	Cercopothecidae
12	Indian Pangolin	*Manis crassicaudata* Gray	Manidae
13	Savi's Pigmy Shrew	*Suncus etruscus nitidofulvas* Anderson	Soricidae
14	House Shrew	*Suncus maurinus maurinus*(Linnaeus)	Soricidae
15	Andeson's Shrew	*Suncus stoliczkanus* Anderson	Soricidae
16	Black Naped Hare	*Lepus nigricollis nigricollis* F. Cuvier	Leporidae
17	Rufous Tailed Hare	*Lepus nigricollis ruficaudatus* Geoffroy	Leporidae
18	Chowsingha	*Tetracerus quadricornis* (Blainville)	Bovidae
19	3/5-Striped Palm Squirrel	*Funambulus pennanti* Wroughton	Sciuridae
20	Field Mouse	*Mus booduga booduga* Gray	Muridae
21	Indian Flying Fox	*Pteropus giganteus* (Brunnich)	Pteropodidae
22	Short Nosed Fruit Bat	*Cynopterus sphinx* (Vahl)	Pteropodidae
23	Fulvus Fruit Bat	*Rousettus leschenaulti leschenaulti* (Desmarest)	Pteropodidae
24	Dark Bellied House Rat	*Rattus rattus rufescens* (Gray)	Muridae
25	Indian Lng Tailed Tree Mouse	*Vandeleuria oleracea* (Bennett)	Muridae
26	Indian Gerbill	*Tatera indica indica* (Hardwicke)	Muridae
27	Indian False Vampire	*Megaderma iyra iyra* Groffroy	Megadermatidae

Birds (188 sps)

1	Black Winged Kite	*Elanus caeruleus* (Desfontaines, 1789)	Accipitridae
2	Crested Serpent Eagle	*Spilornis cheela* (Latham, 1790)	Accipitridae
3	Egyptian Vulture	*Neophron percnopterus* (Linnaeus, 1758)	Accipitridae
4	Indian Vulture	*Gyps indicus* (Scopoli, 1786)	Accipitridae
5	Oriental Honey Buzzard	*Pernis ptilorhynchus* (Temminck, 1821)	Accipitridae
6	White-rumped Vulture	*Gyps bengalensis* (Gmelin, 1788)	Accipitridae
7	Red-headed Vulture	*Sacrogyps calvus* (Scopoli, 1786)	Accipitridae
8	Short-toed Snake Eagle	*Circaetus gallicus* (Gmelin, 1788)	Accipitridae
9	Bonelli's Eagle	*Aquila fasciata* (Vieillot, 1822)	Accipitridae
10	Eurasian Marsh Harrier	*Circus aeruginosus* (Linnaeus, 1758)	Accipitridae
11	Pallid Harrier	*Circus macrourus* S. G. Gmelin, 1770	Accipitridae
12	Eurasian Sparrowhawk	*Accipiter nisus* (Linnaeus, 1758)	Accipitridae
13	White-eyed Buzzard	*Butastur teesa* (Franklin, 1831)	Accipitridae
14	Shikra	*Accipiter badius* (J.F. Gmelin, 1788)	Accipitridae
15	Common Kingfisher	*Alcedo atthis* (Linnaeus, 1758)	Alcedinidae
16	Pied Kingfisher	*Ceryle rudis* (Linnaeus, 1758)	Alcedinidae
17	Stork Billed Kingfisher	*Pelargopsis capensis* (Linnaeus, 1766)	Alcedinidae
18	White Throated Kingfisher	*Halcyon smyrnensis* (Linnaeus, 1758)	Alcedinidae
19	Lesser Whistling Duck	*Dendrocygna javanica* (Horsfield, 1821)	Anatidae
20	Fulvous Whistling Duck	*Dendrocygna bicolor* (Vieillot, 1816)	Anatidae
21	Greylag Goose	*Anser anser* (Linnaeus, 1758)	Anatidae
22	Bar-headed Goose	*Anser indicus* (Latham, 1790)	Anatidae
23	Knob-billed Duck	*Sarkidiornis melanotos* (Pennant, 1769)	Anatidae
24	Ruddy Shelduck	*Tadorna ferruginea* (Pallas, 1764)	Anatidae
25	Cotton Pygmy-goose	*Nettapus coromandelianus* Gmelin, 1789	Anatidae
26	Gadwall	*Mareca strepera* (Linnaeus, 1758)	Anatidae
27	Eurasian Wigeon	*Mareca penelope* (Linnaeus, 1758)	Anatidae
28	Indian Spot-billed	*Anas poecilorhyncha* Forster, 1781	Anatidae

29	Northern Shoveller	*Anas clypeata* (Linnaeus, 1758)	Anatidae
30	Northern Pintail	*Anas acuta* Linnaeus, 1758	Anatidae
31	Garganey	*Anas querquedula* (Linnaeus, 1758)	Anatidae
32	Common Teal	*Anas crecca* Linnaeus, 1758	Anatidae
33	Red-crested Pochard	*Netta rufina* (Pallas, 1773)	Anatidae
34	Common Pochard	*Aythya ferina* (Linnaeus, 1758)	Anatidae
35	Ferruginous Pochard	*Aythya nyroca* (Güldenstädt, 1770)	Anatidae
36	Tufted Duck	*Aythya fuligula* (Linnaeus, 1758)	Anatidae
37	Darter	*Anhinga melanogaster* (Pennant, 1769)	Anhingidae
38	Yellow Bittern	*Ixobrychus sinensis* (Gmelin, 1789)	Ardeidae
39	Cinnamon Bittern	*Ixobrychus cinnamomeus* (Gmelin, 1789)	Ardeidae
40	Black Bittern	*Dupetor flavicollis* (Latham, 1790)	Ardeidae
41	Striated Heron	*Butorides striata* (Linnaeus, 1758)	Ardeidae
42	Black-crowned Night Heron	*Nycticorax nycticorax* (Linnaeus, 1758)	Ardeidae
43	Indian Pond Heron	*Ardeola grayii* (Sykes, 1832)	Ardeidae
44	Grey Heron	*Ardea cinerea* Linnaeus, 1758	Ardeidae
45	Purple Heron	*Ardea purpurea* (Linnaeus, 1766)	Ardeidae
46	Cattle Egret	*Bubulcus ibis* (Linnaeus, 1758)	Ardeidae
47	Great Egret	*Casmerodius albus* Linnaeus, 1758	Ardeidae
48	Intermediate Egret	*Mesophoyx intermedia* Wagler, 1827	Ardeidae
49	Little Egret	*Egretta garzetta* (Linnaeus, 1766)	Ardeidae
50	Western Reef Egret	*Egretta gularis* (Bosc, 1792)	Ardeidae
51	Indian Grey Hornbill	*Ocyceros birostris* (Scopoli, 1786)	Bucerotidae
52	Common Woodshrike	*Tephrodornis pondicerianus* (Gmelin, 1789)	Campephagidae
53	Large Cuckooshrike	*Coracina macei*(Lesson, 1830)	Campephagidae
54	Black-winged Cuckooshrike	*Lalage melaschistos* (Hodgson, 1836)	Campephagidae
55	Black-headed Cuckooshrike	*Lalage melanoptera* (Rüppell, 1839)	Campephagidae
56	White-bellied Minivet	*Pericrocotus erythropygius* (Jerdon, 1840)	Campephagidae
57	Small Minivet	*Pericrocotus cinnamomeus* (Linnaeus, 1766)	Campephagidae
58	Long-tailed Minivet	*Pericrocotus ethologus* (Bangs & Phillips, 1914)	Campephagidae
59	Indian Nightjar	*Caprimulgus asiaticus* Latham, 1790	Caprimulgidae
60	Little Ringed Plover	*Charadrius dubius* Scopoli, 1786	Charadriidae

61	Red Wattled Lapwing	*Vanellus indicus* (Boddaert, 1783)	Charadriidae
62	Yellow Wattled Lapwing	*Vanellus malabaricus* (Boddaert, 1783)	Charadriidae
63	Painted Stork	*Mycteria leucocephala* (Pennant, 1769)	Ciconiidae
64	Asian Openbill	*Anastomus oscitans* (Boddaert, 1783)	Ciconiidae
65	Black Stork	*Ciconia nigra* (Linnaeus, 1758)	Ciconiidae
66	Wooly-necked Stork	*Ciconia episcopus* (Boddaert, 1783)	Ciconiidae
67	White Stork	*Ciconia ciconia* (Linnaeus, 1758)	Ciconiidae
68	Black-necked Stork	*Ephippiorhynchus asiaticus* (Latham, 1790)	Ciconiidae
69	Lesser Adjutant	*Leptoptilos javanicus* Horsfield, 1821	Ciconiidae
70	Jungle Prinia	*Prinia sylvatica* (Jerdon, 1840)	Cisticolidae
71	Ashy Prinia	*Prinia socialis* (Sykes, 1832)	Cisticolidae
72	Plain Prinia	*Prinia inornata* (Sykes, 1832)	Cisticolidae
73	Emerald Dove	*Chalcophaps indica* (Linnaeus, 1758)	Columbidae
74	Eurasian Collered Dove	*Streptopelia decaocto* (Frivaldszky, 1838)	Columbidae
75	Rock Pigeon	*Columba livia* J.F. Gmelin, 1789	Columbidae
76	Spotted Dove	*Spilopelia chinensis* (Scopoli, 1786)	Columbidae
77	Yellow Legged Green Pigeon	*Treron phoenicopterus* (Latham, 1790)	Columbidae
78	Oriental Turtle Dove	*Streptopelia orientalis* (Latham, 1790)	Columbidae
79	Laughing Dove	*Stigmatopelia senegalensis* (Linnaeus, 1766)	Columbidae
80	Indian Jungle Crow	*Corvus macrorhynchos* Wagler, 1827	Corvidae
81	House Crow	*Corvus splendens* Vieillot, 1817	Corvidae
82	Rufous Treepie	*Dendrocitta vagabunda* (Latham, 1790)	Corvidae
83	Asian Koel	*Eudynamys scolopaceus* (Linnaeus, 1758)	Cuculidae
84	Common Hawk Cuckoo	*Hierococcyx varius* (Vahl, 1797)	Cuculidae
85	Pied Cuckoo	*Clamator jacobnus* (Boddaert, 1783)	Cuculidae
86	Black Drongo	*Dicrurus macrocercus* Vieillot, 1817	Dicruridae
87	Greater Racket-Tailed Drongo	*Dicrurus paradiseus* (Linnaeus, 1766)	Dicruridae
88	Crested Bunting	*Melophus lathami* (Gray, 1831)	Emberizidae
89	Red Avadavat	*Amandava amandava* (Linnaeus, 1758)	Estrildidae
90	Scaly-breasted Munia	*Lonchura punctulata* (Linnaeus, 1758)	Estrildidae
91	Common Kestrel	*Falco tinnunculus* Linnaeus, 1758	Falconidae
92	Plain Martin	*Riparia paludicola* (Vieillot, 1817)	Hirundinidae
93	Streak-throated Swallow	*Petrochelidon fluvicola* Blyth, 1855	Hirundinidae

94	Wire-tailed Swallow	*Hirundo smithii* Leach, 1818	Hirundinidae
95	Barn Swallow	*Hirundo rustica* Linnaeus, 1758	Hirundinidae
96	Golden-fronted Leafbird	*Chloropsis aurifrons* (Temminck, 1829)	Chloropseidae
97	Bronze Winged Jacana	*Metopidius indicus* (Latham, 1790)	Jacanidae
98	Pheasant-tailed Jacana	*Hydrophasianus chirurgus* (Scopoli, 1786)	Jacanidae
99	Brown Shrike	*Lanius cristatus* (Linnaeus, 1758)	Laniidae
100	Isabelline Shrike	*Lanius isabellinus* Hemprich & Ehrenberg, 1833	Laniidae
101	Bay-backed Shrike	*Lanius vittatus* (Valenciennes, 1826)	Laniidae
102	Long-tailed Shrike	*Lanius schach* Linnaeus, 1758	Laniidae
103	Green Bee-eater	*Merops orientalis* Latham, 1801	Meropidae
104	Blue-tailed Bee-eater	*Merops philippinus* Linnaeus, 1766	Meropidae
105	Black-naped Monarch	*Hypothymis azurea* (Boddaert, 1783)	Monarchidae
106	Asian Paradise-flycatcher	*Terpsiphone paradisi* (Linnaeus, 1758)	Monarchidae
107	Yellow Wagtail	*Motacilla flava* Linnaeus, 1758	Motacillidae
108	Citrine Wagtail	*Motacilla citreola* (Pallas, 1776)	Motacillidae
109	Grey Wagtail	*Motacilla cinerea* Tunstall, 1771	Motacillidae
110	Paddyfield Pipit	*Anthus rufulus* (Vieillot, 1818)	Motacillidae
111	Tawny Pipit	*Anthus campestris* (Linnaeus, 1758)	Motacillidae
112	Blyths Pipit	*Anthus godlewskii* (Taczanowski, 1876)	Motacillidae
113	Bluethroat	*Luscinia svecica* (Linnaeus, 1758)	Muscicapidae
114	Common Stonechat	*Saxicola torquatus* (Linnaeus, 1766)	Muscicapidae
115	Oriental Magpie Robin	*Copsychus saularis* (Linnaeus, 1758)	Muscicapidae
116	Red Breasted Flycatcher	*Ficedula parva* (Bechstein, 1792)	Muscicapidae
117	Verediter Flycatcher	*Eumyias thalassinus* (Swainsin, 1838)	Muscicapidae
118	Purple -rumped sunbird	*Leptocoma zeylonica* (Linnaeus, 1766)	Nectariniidae
119	Purple Sunbird	*Cinnyris asiaticus* Latham, 1790	Nectariniidae
120	Indian Golden Oriole	*Oriolus kundoo* Sykes, 1832	Oriolidae
121	Black-hooded Oriole	*Oriolus xanthornus* (Linnaeus, 1758)	Oriolidae
122	House Sparrow	*Passer domesticus* (Linnaeus, 1758)	Passeridae

123	Chestnut-shouldered Petronia	*Gymnoris xanthocollis* (Burton, 1838)	Passeridae
124	Painted Francolin	*Francolinus pictus* (Jardine & Selby, 1828)	Phasianidae
125	Grey Francolin	*Francolinus pondicerianus* (Gmelin, 1789)	Phasianidae
126	Rain Quail	*Coturnix coromandelica* (Gmelin, 1789)	Phasianidae
127	Jungle Bush Quail	*Perdicula asiatica* (Latham, 1790)	Phasianidae
128	Rock Bush Quail	*Perdicula argoondah* (Sykes, 1832)	Phasianidae
129	Red Spurfowl	*Galloperdix spadicea* (Gmelin, 1789)	Phasianidae
130	Painted Spurfowl	*Galloperdix lunulata* (Valenciennes, 1825)	Phasianidae
131	Red Junglefowl	*Gallus gallus* (Linnaeus, 1758)	Phasianidae
132	Indian Peafowl	*Pavo cristatus* Linnaeus, 1758	Phasianidae
133	Greater Flamingo	*Phoenicopterus roseus* Pallas, 1811	Phoenicopteridae
134	Eurasian Wryneck	*Jynx torquilla* (Linnaeus, 1758)	Picidae
135	Brown-capped Pygmy Woodpecker	*Dendrocopos nanus* (Vigors, 1832)	Picidae
136	Yellow-crowned Woodpecker	*Dendrocopos mahrattensis* (Latham, 1801)	Picidae
137	Streak-throated Woodpecker	*Picus xanthopygaeus* (Gray & Gray, 1847)	Picidae
138	Lesser Goldenback	*Dinopium benghalense* (Linnaeus, 1758)	Picidae
139	White-naped Woodpecker	*Chrysocolaptes festivus* (Boddaert, 1783)	Picidae
140	Indian Pitta	*Pitta brachyura* (Linnaeus, 1766)	Pittidae
141	Little Grebe	*Tachybaptus ruficollis* (Pallas, 1764)	Podicipedidae
142	Great Crested Grebe	*Podiceps cristatus* (Linnaeus, 1758)	Podicipedidae
143	Plum Headed Parakeet	*Psittacula cyanocephala* (Linnaeus, 1766)	Psittaculidae
144	Rose Ringed Parakeet	*Psittacula kremeri* (Scopoli, 1769)	Psittaculidae
145	Alexandrine Parakeet	*Psittacula eupatria* (Linnaeus, 1766)	Psittaculidae
146	Red-whiskered Bulbul	*Pycnonotus jocosus* (Linnaeus, 1758)	Pycnonotidae
147	Red-vented Bulbul	*Pycnonotus cafer* (Linnaeus, 1766)	Pycnonotidae
148	Common Moorhen	*Gallinula chloropus* (Linnaeus, 1758)	Rallidae
149	Purple Swamphen	*Porphyrio porphyrio* (Linnaeus, 1758)	Rallidae
150	White Breasted Waterhen	*Amaurornis phoenicurus* (Pennant, 1769)	Rallidae
151	Brown Crake	*Amaurornis akool* (Sykes, 1832)	Rallidae
152	Eurasian Coot	*Fulica atra* Linnaeus, 1758	Rallidae
153	Coppersmith Barbet	*Psilopogon haemacephalus* (Statius Muller, 1776)	Ramphastidae

154	White-throated Fantail	*Rhipidura albicollis* (Vieillot, 1818)	Rhipiduridae
155	White-spotted Fantail	*Rhipidura albogularis* (Lesson, 1831)	Rhipiduridae
156	White-browed Fantail	*Rhipidura aureola* Lesson, 1830	Rhipiduridae
157	Eurasian Curlew	*Numenius arquata* (Linnaeus, 1758)	Scolopacidae
158	Spotted Redshank	*Tringa erythropus* (Pallas, 1764)	Scolopacidae
159	Wood Sandpiper	*Tringa glareola* Linnaeus, 1758	Scolopacidae
160	Indian Scops Owl	*Otus bakkamoena* Pennant, 1769	Strigidae
161	Spotted Owlet	*Athene brama* (Temminck, 1821)	Strigidae
162	Eurasian Eagle Owl	*Bubo bubo* (Linnaeus, 1758)	Strigidae
163	Dusky Eagle Owl	*Bubo coromandus* (Latham, 1790)	Strigidae
164	Tawny Fish Owl	*Ketupa flavipes* (Hodgson, 1836)	Strigidae
165	Mottled Wood Owl	*Strix ocellata* (Lesson, 1839)	Strigidae
166	Jungle Owlet	*Glaucidium radiatum*(Tickell, 1833)	Strigidae
167	Oriental Scops owl	*Otus sunia* (Hodgson, 1836)	Strigidae
168	Jungle Myna	*Acridotheres fuscus* (Wagler, 1827)	Sturnidae
169	Bank Myna	*Acridotheres ginginianus* (Latham, 1790)	Sturnidae
170	Common Myna	*Acridotheres tristis* (Linnaeus, 1766)	Sturnidae
171	Asian Pied Starling	*Gracupica contra* (Linnaeus, 1758)	Sturnidae
172	Brahminy Starling	*Sturnia pagodarum* (Gmelin, 1789)	Sturnidae
173	Rosy Starling	*Pastor roseus* (Linnaeus, 1758)	Sturnidae
174	Paddyfield Warbler	*Acrocephalus agricola* (Jerdon, 1845)	Sylviidae
175	Common Chiffchaff	*Phylloscopus collybita* (Vieillot, 1817)	Sylviidae
176	Greenish Warbler	*Phylloscopus trochiloides* (Sundevall, 1837)	Sylviidae
177	Black-headed Ibis	*Threskiornis melanocephalus* (Latham, 1790)	Threskiornithidae
178	Red-naped Ibis	*Pseudibis papillosa* (Temminck, 1824)	Threskiornithidae
179	Eurasian Spoonbill	*Platalea leucorodia* Linnaeus, 1758	Threskiornithidae
180	Common Babbler	*Argya caudata* (Dumont, 1823)	Timaliidae
181	Large Grey Babbler	*Argya malcolmi* (Sykes, 1832)	Timaliidae
182	Jungle Babbler	*Argya striata* (Dumont, 1823)	Timaliidae
183	Orange - headed Thrush	*Zoothera citrina* (Latham, 1790)	Turdidae
184	Small Buttonquail	*Turnix sylvaticus*Desfontaines, 1789	Turnicidae
185	Barred Buttonquail	*Turnix suscitator* (Gmelin, 1789)	Turnicidae
186	Common Barn owl	*Tyto alba* (Scopoli, 1769)	Tytonidae
187	Common Hoopoe	*Upupa epops* Linnaeus, 1758	Upupidae

Reptiles (15 sps)

1	Marsh Crocodile	*Crocodylus palustris* Lesson	Crocodylidae
2	Bengal Monitor	*Varanus bengalensis* Daudin	Varanidae
3	Leaf-toed Gecko	*Hemidactylus leschenaulti* Dumeril and Bibron	Gekkonidae
4	Common House Gecko	*Hemidactylus frenatus* Schlegel	Gekkonidae
5	Spotted House Gecko	*Hemidactylus brookii* Gray	Gekkonidae
6	Yellow-belly Gecko	*Hemidactylus flaviviridis* Rupell	Gekkonidae
7	Common Garden Lizard	*Calotes versicolor* (Daudin)	Agamidae
8	Dwarf Rock Agama	*Agama minor* Hardwicke and Gray	Agamidae
9	Fan Throated Lizard	*Sitana ponticeriana* (Cuvier)	Agamidae
10	Indian Chameleon	*Chamaeleo zeylanicus* Laurenti	Chamaeleonidae
11	Golden Skink	*Mabuya carinata* (Schneider)	Scincidae
12	Striped Grass Skink	*Mabuya dissimilis* (Hallowell)	Scincidae
13	Bronze Grass Skink	*Mabuya macularia* (Blyth)	Scincidae
14	White-spotted Supple Skink	*Lygosoma albopunctata* (Gray)	Scincidae
15	Common Snake Skink	*Lygosoma punctata* Gmelin	Scincidae
		Snakes (16 sps)	
1	Indian Cobra	*Naja naja* (Linn.)	Elapidae
2	Common Krait	*Bungarus caeruleus* (Schneider)	Elapidae
3	Russell's Viper	*Vipera russelli* (Shaw)	Viperidae
4	Saw-scaled Viper	*Echis carinatus* (Schneider)	Viperidae
5	Common Kukri	*Oligodon arnensis* Shaw	Colubridae
6	Indian Rock Python	*Python molurus* (Linn.)	Boidae
7	Common Trinket	*Elaphe helena* (Daudin)	Colubridae
8	Indian Rat Snake	*Ptyas mucosa* (Linn.)	Colubridae
9	Common Bronzeback Tree Snake	*Dendrelaphis tristis* (Daudin)	Colubridae
10	Travancore Wolf Snake	*Lycodon travancoricus* Beddome	Colubridae
11	Checkered Keelback	*Xenochrophis piscator* (Schneider)	Colubridae

12	Buff Striped Keelback	*Amphiesma stolatum* (Linn.)	Colubridae
13	Common Blind Snake	*Indotyphlops braminus* (Daudin)	Typhlopidae
14	Common Bamboo Viper	*Trimeresurus gramineus* (Shaw)	Viperidae
15	Banded Racer	*Coluber fasciolatus* Shaw	Colubridae
16	Common Sand Boa	*Eryx conicus* (Schneider)	Boidae
Amphibians (8 sps)			
1	Common Toad	*Bufo melanostictus* Schneider	Bufonidae
2	Indian Bullfrog	*Hoplobatrachus tigerinus* (Daudin)	Ranidae
3	Common Tree Frog	*Polypedates maculatus* Gray	Ranidae
4	Ornate Narrow mouthed Frog	*Microhyla ornata* (Duméril and Bibron)	Microhylidae
5	Indian Burrowing Frog	*Tomopterna breviceps* (Schneider)	Ranidae
6	Indian Balloon Frog	*Uperodon globulosus* (Gunther)	Microhylidae
7	Indian skipper frog	*Rana cyanophlyetis* Schneider	Ranidae
8	Indian cricket frog	*Rana limnocharis* Gravenhorst	Ranidae
Butterflies (34 sps)			
1	Common Mormon	*Papilio polytus romulus* Cramer	Papilionidae
2	Blue Mormon	*Papilio polymnestor* Cramer	Papilionidae
3	Lime	*Papilio demoleus demoleus* Linnaeus	Papilionidae
4	Common Grass Yellow	*Terias hecabe simulata* (Moore)	Pieridae
5	Small Grass Yellow	*Terias laeta laeta* (Boisduval)	Pieridae
6	Small Grass Yellow	*Terias brigitta rubella* (Wallace)	Pieridae
7	Common Jezebel	*Delias eucharis* (Drury)	Pieridae
8	Crimson Rose	*Pachliopta hector* (Linnaeus)	Papilionidae
9	Common Wanderer	*Pareronia valeria hippia* (Fabricius)	Pieridae
10	Lemon Pansy	*Junonia lemonias vaisya* Fruhstorfer	Nymphalidae
11	Grey Pansy	*Junonia atlites* (Linnaeus)	Nymphalidae
12	Blue Pansy	*Junonia orithya swinhoei* Butler	Nymphalidae
13	Peacock Pansy	*Junonia almana almana* (Linnaeus)	Nymphalidae
14	Yellow Pansy	*Junonia hierta hierta* (Fabricius)	Nymphalidae
15	Chocolate Pansy	*Junonia iphita* (Cramer)	Nymphalidae
16	Common Sailor	*Neptis hylas astola* Moore	Nymphalidae
17	Sullied Sailor	*Neptis soma soma* Moore	Nymphalidae

18	Baronet	*Symphaedra nais* (Forster)	Nymphalidae
19	Plain Tiger	*Danaus chrysippus chrysippus* (Linnaeus)	Danaidae
20	Common Tiger	*Danaus genutia* (Cramer)	Danaidae
21	Common Crow	*Euploea core core* (Cramer)	Danaidae
22	Mottled Emigrant	*Catopsilia pyranthe pyranthe* (Linnaeus)	Pieridae
23	Small Branded Swift	*Pelopidas mathias* (Fabricius)	Hesperiidae
24	Stipped Pierrot	*Tarucus nara* (Kollar)	Lycaenidae
25	Commander	*Limenitis procris* (Cramer)	Nymphalidae
26	Common Leopard	*Phalanta phalantha* (Drury)	Nymphalidae
27	Spotless Grass Yellow	*Eurema laeta* (Boisduval)	Pieridae
28	Spot Swordtail	*Graphium nomius* (Esper)	Papilionidae
29	Painted Lady	*Cynthia cardui* (Linnaeus)	Nymphalidae
30	Indian Skipper	*Spialia galba* (Fabricius)	Hesperiidae
31	Small Cupid	*Chilades parrhasius* (Butler)	Lycaenidae
32	Plains Cupid	*Chilades pandava* (Horsfield)	Lycaenidae
33	Common Five Ring	*Ypthima baldus* (Fabricius)	Nymphalidae
34	Three-Spot Grass Yellow	*Eurema blanda* (Boisduval)	Pieridae
Dragon & Damselflies (19 sps)			
1	Green Marsh Hawk	*Orthetrum sabina sabina* (Drury)	Libellulidae
2	Ground Skimmer	*Diplacodes trivialis* (Rambur)	Libellulidae
3	Ruddy Marsh Skimmer	*Crocothemis servilia* (Drury)	Libellulidae
4	Pygmy Dartlet	*Agriocnemis pygmaea* (Rambur)	Coenagrionidae
5	Coromandel Marsh Dart	*Ceriagrion coromandelianum* (Fabricius)	Coenagrionidae
6	Three Striped Blue Dart	*Pseudagrion decorum* (Rambur)	Coenagrionidae
7	Crimson-tailed Marsh Hawk	*Orthetrum pruinosum neglectum* (Rambur)	Libellulidae
8	Blue Marsh Hawk	*Orthetrum glaucum* (Brauer)	Libellulidae
9	Common Chaser	*Potamarcha congener* (Rambur)	Libellulidae
10	Blue Grass Dart	*Pseudagrion microcephalum* (Rambur)	Coenagrionidae
11	Splendid Dartlet	*Agriocnemis splendidissima* Laidlaw	Coenagrionidae
12	Green Striped Slender Dartlet	*Aciagrion occidentale* (Laidlaw)	Coenagrionidae
13	Golden Darlet	*Ischnura aurora* (Rambur)	Coenagrionidae
14	Ditch Jewel	*Brachythemis contaminata* (Fabricius)	Libellulidae
15	Granite Ghost	*Bradinopyga geminata* (Rambur)	Libellulidae

16	Long-legged Marsh Glider	*Trithemis pallidinervis* (Kirby)	Libellulidae
17	Black Stream Glider	*Trithemis festiva* (Rambur)	Libellulidae
18	Globe Wanderer	*Pantala flavescens* (Fabricius)	Libellulidae
19	Lesser Green Emperor	*Anax guttatus* (Burmeister)	Aeshnidae

of these floral species. Authors are also thankful to The President of Uttar Pradesh Higher education Prayagraj, Uttar Pradesh.

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EFFECT OF DIFFERENT COMBINATIONS OF GROOMING AND BATHING ON MILK YIELD AND MICROBIAL QUALITY OF RAW MILK DURING RAINY SEASON IN CROSS-BRED COWS

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ABSTRACT

The present study was undertaken to find out the effect of different combinations of grooming and bathing on milk yieldand microbial quality of raw milk during rainy season in cross-bred cows. Twelve apparently healthy and randomly selected cross-bred cows, housed in tail to tail barn under similar management conditions at SHUATS dairy farm, Prayagraj. Were subjected to different treatments as T0 (Cows milked without grooming and bathing as control), T1 (Cows groomed and bathed once a day), T2 (Cows groomed twice and bathed once a day) and T3 (Cows groomed and bathed twice a day). All sanitary precautions were undertaken to produce clean milk by dry full had method of milking. Per day milk yield (kg) of cows under different treatments were recorded and representative samples of milk were used to determine the milk yield and microbial quality of raw milk for Standard Plate Count (SPC), Lactic Acid Bacterial Count (LABC), Lipolytic bacterial count (LBC), Proteolytic bacterial count (PBC) and Coliforms in raw milk. Statistical analysis of data on milk yield and microbial quality of raw milk as influenced by different treatments of grooming and bathing combination in cross-bred cows revealed significant effect differences on per day milk yield, SPC, LABC, LBC, and PBC excluding coliforms in milk. Results of the experiment clearly indicated that the bacteriological quality of raw milk adjudged on the basis of SPC and four physiological groups of bacteria was found best in T3 followed by T2, T1 and control indicating thereby superiority of T3 over rest of the treatments of grooming and bathing combination.

Keywords : *Grooming and bathing combinations, milk yield, microbial quality, raw milk*

INTRODUCTION

Milk is naturally major part of ideal and almost perfect food considered necessary for newly born and young mammals. In true senses there is no substitute of milk but because of possibility of it being potent source of biological and chemical hazards it cannot be considered totally safe, if not produced and handled under hygienic conditions. Milk production in India is growing at 4.2% per year and at present it contributes to around 15% of the

total global milk output. (**Patel, 2013)** Total annual milk production of India reachedto 187.7 million tons whereas per day per capita availability of milk in the country has reached to 394 in 2018-19 **(Rath, 2019)** this achievement in milk production sector could be attributed to increase in the population of high yielding dairy animals. Sincere efforts of dairy farmers, technical experts, scientists and visionaries working for upliftment of dairy sector in India. Present scenario indicates that Indian agribusiness is an economic symbiosis of crop and dairy production, System which serves as major source of income, and provides employment to millions of rural populations in India. The country would have achieved remarkable level of milk Production but controversies, constraints and hurdles in dairy development in spite of its important role, the domestic animals' improvement projects with regard to breeding, feeding, management and health cover has been neglected up to a certain extent. "Failure is never last and success is never finished", Dr. N.D.D.B., Varghese Kurein made a statement perfectly to describe the current status of dairy production in India. As on today even, the weakest connection in the chain of dairy industry is the milk from milk producer to end user. This need to be addressed by introducing concept of milk production at the village level. It is encouraging that the concept of clean and safe milk production has recently gained momentum from milk producer to dairy stock for better quality. It has become an imperative for Indian dairy producers to produce clean and safe milk of good quality. India is highest milk producing country in the world but this is supported by majority of non- descript cattle with low production ability. India maintains almost 1/6 of the world's cattle and over of the ½ worlds buffalo's population

Table - 1.1 : Milk production and per capita per day availability of milk in India

Year	Per capita per day availability of milk (gram)	Annual milk Production in (Million Metric Tons)
1999-2000	217	78.3
2000-2001	220	80.6
2001-2002	225	84.4
2002-2003	230	86.2
2003-2004	231	88.1
2004-2005	233	92.5
2005-2006	241	97.1
2006-2007	251	102.6
2007-2008	260	107.9
2008-2009	266	112.2
2009-2010	273	116.4
2010-2011	281	121.8
2011-2012	281	127.9
2012-2013	290	132.4
2013-2014	291	134.5
2014-2015	322	146.3
2015-2016	337	155.5
2016-2017	355	165.4
2017-2018	379	176.36
2018-2019	394	187.7

(Source:National Dairy Development Board, 2018-19)

Table - 1.2 : Livestock population (Census, 2012) in India and world (Million)

Type of animal	India		World	
	Total No. (Million)	Per cent of world population	Total No. (Million)	Per cent
Cattle	190.90	13.81	1382.2	100
Buffalo	108.70	57.72	188.3	100
Goat	135.17	15.57	868.0	100
Sheep	65.06	06.07	1071.3	100
Pig	10.29	01.09	941.2	100
Chicken	729.20	03.92	18554.8	100

(Source : www.fao.org)

MATERIALS AND METHODS

From the herd consisting of cows at SHUATS dairy farm, Allahabad, twelve healthy cows free from mastitis as detected by Californian Mastitis Test **(Schalm and Noorlander, 1957)** and other noticeable udder infection or injuries were randomly selected for this experiment. All elected cows were housed in tail to tail barn set up for milking and dry full hand method of milking was followed. Samples of milk were collected for control and different combinations of grooming and bathing on microbial quality of raw milk in rainy season. Ten replications were made under each treatment including control. First two streams of milk from all quarters were deported as a scale of recommended common practice**.** Milk samples collected were tested for determiningthe total bacterial count in raw milk by Standard plate bacterial count (SPC) and population density of four physiological groups of bacteria viz. Lactic acid bacterial count (LABC), Lipolytic bacterial count (LBC), Proteolytic bacterial count (PBC) and Coliform count. Representative specimens of 200 ml raw milk was collected in purify conical flasks of 250 ml efficiency and plugged aseptically with cotton plugs. These samples were brought immediately to the laboratory for determination of microbial quality of raw milk. The data collected on microbial parameters were collected recorded, tabulated and analyzed statistically using Analysis of Variance Technique (ANOVA) as per **Snedecor and Cochran (2004).**

RESULTS AND DISCUSSION

Mean values of different parameters used to determine the effect of different combinations of grooming and bathing on bacteriological quality of raw milk during winter season in cows are presented in the Table Mean value of different parameters to determine the effect of different combination of grooming and bathing on milk yield and microbial quality of raw milk in rainy season.

Parameters	Different combinations of grooming and bathing on milk yield and microbial quality of raw milk during rainy season in cross-bred cows			
	T_0	T_1	T_2	T_3
Milk yield (kg)	2.63	2.73	2.84	4.35
SPC (10^4)/ ml	52.5	48.00	38.00	46.07
LABC (10^3)/ ml	33.02	34.06	33.08	34.04
LBC (10^2)/ ml	43.8	42.2	37.3	38.4
PBC (10^2)/ ml	30.2	29.03	27.08	29.2
Coliform (10)/ml	2.0	1.0	1.0	0.0

The data on per day milk yield of cows contained in Table indicated that irrespective of different treatments, average milk yield of cows per day ranged from **2.63** to **4.35** kg. Highest milk yield of cows per day (kg) was recorded in T_3 (**4.35**), followed by T_2 (**2.84**), T_1 (**2.73**) and T_0 (**2.63**). Differences in these values were found significant indicating thereby significant effect of different treatments of grooming and bathing combinations on milk yield.

However, differences in the values of SPC between T_3, T_1 and T_0 were found at par. Lowest mean SPC (10^4) per ml milk was observed as **38.00** in T_2 followed by **46.07** in T_3, **48.00** in T_1 and **52.5** in T_0. The differences in these values were found significant indicating thereby a significant effect of different combinations of grooming and bathing on SPC/ ml of milk during rainy season. Results revealed that SPC per ml in milk of T_2 was significantly lowest however differences in the values of SPC between T_0 and T_1, and T_3 were found significant being at par.

Lowest mean LABC (10^3) per ml milk was recorded as **33.02** in T_0 followed by **33.08** in T_2, 34.04 in T_3 and **34.06** in T_1. The differences in these values were found non-significant indicating thereby a significant effect of different combinations of grooming and bathing on LABC/ml of milk. Results revealed non-significantly less count of LABC/ml in milk of T_0 compared to all other combinations of grooming and bathing indicating thereby superiority of T_0 over rest of the treatments. However, differences in the values of LABC between T_0 and T_2, T_3 and T_1, were found non-significant.

However, differences in the values of PBC between T_2, T_3 and also between T_1 and T_1 were found non-significant, being at par. Lowest mean PBC (10^2) per ml milk was recorded 27.08 in T_2 followed by 29.02 in T_3, 29.03 in T_1 and 30.2 in T_0. The differences only these values were found non-significant indicating by their non-significant effect of different combinations of grooming and bathing on PBC/ml raw of milk.

However, different in the values of LBC/ml milk between T_2, T_3 and T_1 were found at par Lowest mean LBC (10^2) per ml milk was recorded as 37.3 in T_2 followed by 38.4 in T_3, 42.2 in T_1 and 43.8 in T_0. The differences in these values were found significant indicating by their significant effect of different combination of grooming and bathing on LBC/ ml of raw milk. Lowest mean Coliforms (10) per ml milk was recorded 0.0 in T_3 and 1.0 in T_2, 1.0 in T_1 and **2.0** in T^0. The differences in the values of coliform per ml milk were found significant.

CONCLUSION

The experimental findings revealed significant effect of different combinations of grooming and bathing on milk yield, Standard plate count, Lactic acid bacterial count, Proteolytic bacterial count and Lipolytic bacterial count except Coliform count in raw milk. Overall rating of quality of raw milk as determined by various bacterial parameters was found best in T_3 indicating its superiority over remaining of different combinations of grooming and bathing. Therefore, use of different combinations of grooming and bathing on may be recommended to the dairy farmers as an alternative to produce milk of low bacterial count.

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SCREENING OF TRICHODERMA SPP. ISOLATES AGAINST RICE ROOT KNOT NEMATODE (MELOIDOGYNE GRAMINICOLA)

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ABSTRACT

Present study was conducted to work out the effectiveness of different isolates of Trichoderma against root knot nematode (Meloidogyne graminicola)of rice. Study consisted of 34 isolates of Trichoderma. All the isolates showed their effectiveness against root knot nematode. Minimum number of galls/plant (0) was recorded in S13 and S32 isolates of Trichoderma, and its maximum number was recorded in S31, S21, S23 and S16. The inoculated isolates increased shoot as well as root length over control. Maximum shoot (95.16 cm) and root length (42.00 cm) were recorded in S35 and S37 isolates of Trichoderma, respectively. Minimum shoot (56.76 cm) and root length (12.33 cm) were recorded in S36 and S34 isolates of Trichoderma, respectively. Thus, the results of present study indicated that the use of Trichoderma isolates could be a better option in integrated nematode management programme (INM) which will reduce environmental pollution.

Keywrods : *Trichoderma root knot nematodes, rice.*

INTRODUCTION

Rice is the second most popular consuming cereal and relished across the globe by around 2.7 billion people. Due to its popularity both locally and internationally, around 40 percent of our food production is dedicated to rice. Rice contains less protein (white rice 6-7% and brown rice 7.9%) and contains 2-2.5% fat which loses during milling. Many pathogens and insect pest attacks onrice crop. Nematodes are important group of pathogens that cause considerable damage and reduce yield of rice. More than 35 genera and 130 species of plant parasitic nematodes are associated with rice (Gerber *et al.* 1987). Rice root knot nematode (*Meloidogyne graminicola*), belonging to family- Heteroderidae,is anendoparasite pest. *Meloidogyne graminicola* has wide host range, affecting cereals such as wheat, barley and some weeds. Out of these, rice has been reported to be a major economically important host. *Meloidogyne graminicola*can survive as eggs or second stage juveniles (J_2) in root pieces or soil and can spreads through infested soil, water and infected seedlings.Symptoms of damage induced by root-knot nematode include patches of stunted and yellow plants, presence of root galls and reduced root system which ultimately cause significant decline in plant growth and grain yield (Khan *et al.,*2012). Juvenile enter in roots system through root tips and starts feeding. The high population of *M. graminicola* causes wilting of seedlings along with severe reduction in plant's growthwhile low populationreducesonly growth.

Rice root knot nematode causes significant yield losses of rice production in upland and rainfed lowland (Jairajpuri and Baqri, 1991 and Soriano *et al.,* 2000). The use of rice seedlings from non-treated nursery beds has result heavy yield loss of rice grain of 38% in comparison to 29% when rice seedlings from treated nursery beds were used (Gaur, 2003). In this condition, crop losses to the extended 60-100% have been reported by Dabur and Jain, (2005). Nationally *M. graminicola* is reported to cause upto 50% loss in grain yield (Rao & Biswas, 1973). Losses in grain yield were also estimated to range from 16-32 % due to this nematode (Rao & Biswas, 1973).The fungal biocontrol agents, *Trichoderma* spp. promotes the plant growth and has the ability to colonize root surfaces and the cortex. Various mechanisms suggested for the bio-control activity of *Trichoderma* spp. against phytonematodes are antibiosis, competition, mycoparasitism and enzymatic hydrolysis. All mechanisms, except competition, might potentially are involved in the nematode biocontrol process. Enzymes such as chitinases, glucanases, and proteases are very important in the mycoparasitic process.Among the different bio-agents, *Trichoderma* has gained maximum attention as biocontrol agent due to the fact that it is effective against a large number of soil-borne plant pathogenic fungi and have the suppressive effects on some root nematodes without adversely affecting beneficial microbes like *Rhizobium* and capable of promoting growth of certain crops. Biological control of soil-borne plant pathogens and nematodes by antagonistic microorganisms is a potential nonchemical disease management practice (Stirling, 1991). A wide range of bacteria (Hallmann*et al*., 2001) and fungal agents (Meyer *et al*., 2001) have used to reduce of plant parasitic nematodes. Some species of *Trichoderma* have used widely as biocontrol agents against soil-borne plant diseases (Whipps, 2001). *Trichoderma* species isolated from different rice growing fields has potential suppressive effect on *M. graminicola*has been reported by (Le *et al*. 2009).*Trichoderma* isolates have used successfully to control the damage caused by soil-borne plant pathogens. *Trichoderma* have antagonistic activity towards root-knot nematode (Sharon *et al*., 2001; Meyer *et al*., 2001). *Trichoderma* spp. found in close association with roots contributes as plant growth stimulators (Ousley *et al*., 1994). Biocontrol technologies have gained momentum in disease control of crop plants in recent times as these technologies not only minimize or replace the usage of harmful chemical pesticides but also found to be cheaper and efficient in certain disease control programmes. Hence, keeping all these points in view, the present investigation was undertaken to evaluate the efficacy of different isolates of *Trichoderma* against rice root knot nematode.

MATERIALS AND METHODS

For evaluating the efficacy of *Trichoderma* spp. against rice root knot nematode, potex periments were carried out in the College of Agriculture, Meerut 29º 01'N and 77º 45'E at an altitude of 237 m above the mean sea level. The general climate of this district is semi-arid and sub-tropical, characterized by very hot summer and cold winters. The maximum temperature shoots up to 42ºC during summer whereas minimum temperatureremains 7- 8ºC and below during winter season. The average annual rainfall is 863 mm, 75-80% of which is received through south west monsoon during the month of July to September.Laboratory experiments were conducted in Nematology Laboratory, Department of Plant Pathology, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, U.P. during

June to July, 2019.

Preparation of sick pot

Forpropagation of pure culture of *M. graminicola*, infected rice roots were collected from Department of Plant Pathology, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut. The infected rice roots were grinded with the help of a grinder. After teasing/grinding, egg and juveniles came out from the roots which were collected and inoculated in earthen pots containing sterilized sandy soil for preparation of sick pot. The sick soil was removed from each pot and mixed properly and filled in the plastic pots @ 250 g per pot. 100 g. soil sample wastaken for estimation of population of second stage juvenile.

Preparation of mass culture of *Trichoderma*

Isolates of *Trichoderma* were isolated from different area of Uttar Pradesh and maintained in the laboratory. The pure culture of each isolate wasmaintained in slants at 5^0C after growing for seven days at 25 ± 2^0C. For mass culture of *Trichoderma*, 50 g wheat grains were taken into 250 ml conical flasks along with 5% dextrose. Wheat grains in each conical flask were moistened with tap water, plugged with cotton and sterilized at 15 lbs/inch2 for 20 minutes. After sterilization, different isolates of *Trichoderma* culture were inoculated in each flask and kept in incubator at 25 ± 2^0C for 7 days.

Mixing of *Trichoderma* isolates in pot soil

Mass culture of 34 isolates was separately amended in the soil @ 2.5 g/ 250 g of soil. Sick soil without bioagentserved as control. Soils amended with bioagent (*Trichoderma* spp.) and without bioagent (*Trichoderma* spp.) were filled in pots at the rate of 250 g/pot. Ten germinated seeds of rice(var. PB-1121) were sown in each pot on the same day. For each treatment, three replications were maintained. Observations on number of root galls, shoot and root length were recorded at 30 days after sowing. Data were analysed using complete lyrandomized design (CRD).

RESULTS AND DISCUSSION

Results revealed that all the isolates of *Trichoderma* were effective against root knot nematode. All isolates reduced the number of galls/plant when compared with control. Minimum number ofgalls/plant were observed in S13 and S32 isolates of *Trichoderma* andmaximum in S31, S21, S23and S16 (05.66). Control plant recorded maximum number of galls/plant.Inoculated isolates improved root and shoot length over control. Maximum shoot (95.16 cm) and root length (42.00 cm) was observed in S35 and S37 isolates of *Trichoderma*, respectively, and their minimum values (56.76 and 12.33 cm) were recorded in S36 and S34 isolates of*Trichoderma.*Control recorded 80.96 cm shoot length and 22.60 cm root length. Several authors have reported the efficacy of fungal bioagents used as soil application in reducing the *Meloidogyne* species populations. Similar result was recorded by Sharon *et al*. (2001).They reportedreduced gall of rootknot nematode (*Meloidogyne javanica)*by applying *Trichoderma harzianum*in tomato. Pandey *et al*. (2003) also recorded similar results in chickpea. They reported that different treatments of *Trichoderma viride*decreased the number of galls of *Meloidogyne incognita* in chickpea.Dababat and Sikora (2007) reported that inoculation of*Trichoderma* before one week of transplantationof tomato seedlings reduced nematode galling up to 38.80%. The biocontrol agents, *T. harzianum*and *T. virens* when applied in soil one week after nematode inoculation significantly improvedplant growth and reduced number of galls (Pankaj *et al*. 2010). Le *et al*. (2009) reported that, isolated *Trichoderma* species from different rice soils are potential biocontrol agents

against*M. graminicola*. Similar results have also been reported by Pavithra and Khatib (2014) who observed that application of *Trichoderma viride*reduced the number of galls and egg masses of *M. incognita* in brinjal intercropped with mustard.

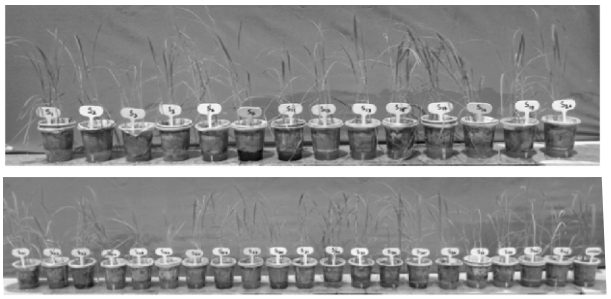

Figure 1: Effect of different isolates of Trichoderma spp. against root knot nematode of riceseedlings

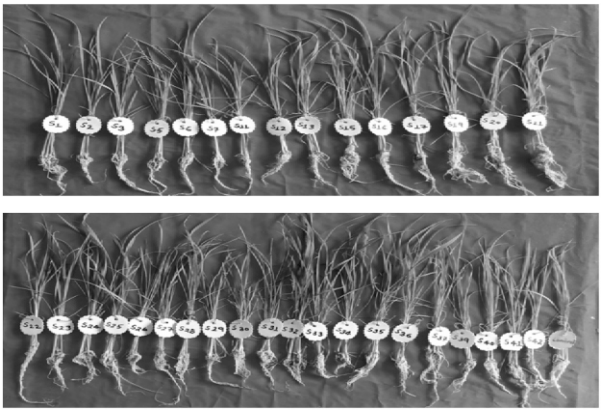

Figure - 2 : Effect of application of *Trichoderma* on gall formation of rice (30 days).

Table-1: Effect of different isolates of *Trichoderma* spp. against root knot disease of rice.

TREATMENTS	AVERAGE ROOT LENGTH (cm)	AVERAGE OF ROOT GALLS/PLANT	AVERAGE OF SHOOT LENGTH (cm)
S1	34.93	2.00	74.33
S2	22.00	1.33	76.33
S3	31.40	2.00	69.10
S5	28.63	1.33	63.16
S6	31.66	3.33	70.90
S7	23.66	0.33	83.33
S11	18.00	0.66	72.00
S12	26.00	2.33	78.33
S13	27.33	0.00	84.00
S15	25.66	0.66	76.66
S16	32.33	5.66	89.00
S17	27.00	2.00	79.66
S19	28.66	1.66	82.00
S20	28.66	3.33	84.66
S21	21.66	6.00	85.33
S22	23.03	2.66	73.36
S23	26.33	6.00	75.23
S24	26.66	1.33	81.80
S25	28.23	0.66	77.33
S26	19.60	1.66	67.13
S27	27.00	2.33	76.50
S28	27.66	1.66	77.90
S29	33.16	2.33	77.76
S30	22.80	1.66	64.36
S31	26.00	16.0	82.13
S32	14.83	0.00	94.80
S33	17.73	0.33	84.40
S34	12.33	1.00	86.00
S35	22.40	1.66	95.16
S36	24.00	3.00	56.76
S37	42.00	1.33	63.33
S39	28.33	4.66	67.66
S40	27.66	4.66	76.33
S42	21.33	3.00	58.33
Control	22.60	11.66	80.96
CD	0.387	0.143	0.588
SE(d)	0.194	0.071	0.294
SE(m)	0.137	0.051	0.208
CV	2.932	10.441	1.462

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A STUDY OF SPIDER DIVERSITY AT RANI DURGAWATI VISHWAVIDYALAYA (RDVV) CAMPUS, JABALPUR (M.P.)

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ABSTRACT

Rani Durgavati Vishwavidyalaya (Rani Durgavati University), also known as University of Jabalpur, is a government university in Jabalpur, Madhya Pradesh, India. It was named after the queen Rani Durgavati. The campus is surrounded with lush green forests which houses several species of flora and fauna. In current study species of spiders are reported belonging to families.

Keywords : *Rani durgavati vishwavidyalaya, jabalpur, spider, madhya pradesh.*

INTRODUCTION

Rani Durgavati Vishwavidyalaya (Rani Durgavati University), also known as University of Jabalpur, is a government university in Jabalpur, Madhya Pradesh, India. It was named after the queen Rani Durgavati. It is the main university of this city and has been graded as A by the National Assessment and Accreditation Council (NAAC). The university campus is spread over 99.63 acres (403,200 m^2) of scenic beauty and environment-friendly surroundings. It accommodates an Administrative Block, Art Faculty building, Teaching and Research buildings of Physics, Chemistry, Mathematics, Bio-Science, System Science and Physical education departments. It has a Central Library, Computer Centre, USIC, University Institute of Management, University Law Department and other facilities like one boys' and one girls' hostels, University Health Centre, University Guest House, Canteen and residential quarters. Other facilities like post office, bank and printing press are on the campus. It is, therefore, possible to say that the university campus is a city within the city of Jabalpur.

Several studies on spiders of India has been conducted by many biologists like Pocock (1900), Tikader (1970, 1977, 1980, 1982), Patel (1975), Tikader & Biswas (1981) and Gajbe & Rane (1992). The spider fauna of Jabalpur district was described by Gajbe & Gajbe (1999 and 2000) and Bhandari & Gajbe (2001), who have described several new species of spiders from Jabalpur. During current study, first of all spiders were located in their preferred habitat (cultivated fields, forests, hilly areas, fruit orchards, human habitations, buildings, gardens, fallow land as well as water bodies). Spider samples were also taken from other locations such as under-stones, loose bark of trees, leaf litter, flowers and on the ground. Samples were also hand collected by using a sweep net, while many spiders were collected by bush beating method with the help of a stick. The spiders were then preserved in 70% ethyl alcohol in small glass vials and were properly labelled. For identification, the samples were examined under a binocular microscope and identified with the help of literature.

MATERIALS AND METHODS

During the survey of the Rani Durgavati Vishwavidyalaya (Rani Durgavati University), also known as University of Jabalpur, by the first author, altogether 48 species of spider were examined from various localities of the CMM by hand picking and net trap methods. The photographed specimens were identified with the help of available literature.

RESULTS AND DISCUSSION

A total of 48 species of spiders belonging to 9 families were recorded. Maximum diversity was shown by the family Araneidae (12 species) which is followed by Thomisidae (10 species), Gnaphosidae (8 species), Lycosidae (6 species), Philodromidae (5 species) and Oxyopidae (4 species). Families Pholcidae, Eresidae and Oecobiidae were represented by single specimen each. The tabular depiction of these species are given as follows –

S. N.	Family	Species
1	Pholcidae	*Artema atlanta*
2	Eresidae	*Stegodyphus sarasinorum*
3	Oecobiidae	*Oecobius putus*
4	Araneidae	*Leucauge decorata*
5		*Nephila maculata*
6		*Argiope aemula*
7		*Chorizopes tikaderi*
8		*Cyrtophora cicatrosa*
9		*Cyrtophora citricola*
10		*Cyrtophora jabalpurensis*
11		*Cyclosa spirifera*
12		*Larinia bharatae*
13		*Neoscona rumpfi*
14		*Neoscona theis*
15		*Neoscona biswasi*
16	Lycosidae	*Hippasa partita*
17		*Hippasa pisaurina*
18		*Hippasa fabreae*
19		*Pardosa jabalpurensis*
20		*Arctosa indicus*
21		*Lycosa shaktae*
22	Oxyopidae	*Oxyopes jabalpurensis*
23		*Oxyopes ketani*
24		*Peucetia jabalpurensis*
25		*Peucetia ashae*
26	Gnaphosidae	*Gnaphosa poonaensis*
27		*Callilepis lambai*
28		*Scopodes maitraiae*
29		*Scotophaeus poonaensis*
30		*Liodrassus tikaderi*
31		*Sostieus jabalpurensis*
32		*Poeeiloehroa barmani*
33		*Zelotes jabalpurensis*
34	Philodromidae	*Philodromus durvei*
35		*Philodromus jabalpurensis*
36		*Philodromus ashae*
37		*Thanatus jabalpurensis*
38		*Thanatus ketani*
39	Thomisidae	*Thomisus sundari*
40		*Thomisus rajani*
41		*Runeinia yogeshi*
42		*Oxyptila amkhasensis*
43		*Oxyptila jabalpurensis*
44		*Xystieus bengalensis*
45		*Xystieus jabalpurensis*
46		*Xystieus bharatae*
47		*Synaema deeorata*
48		*Monaeses jabalpurensis*

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