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EFFECT OF ORGANIC MANURES ON GROWTH, YIELD AND QUALITY OF BEET ROOT [BETA VULGARIS L.] CV. CRIMSON GLOBE

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ABSTRACT

A field experiment was conducted during rabi, 2021 to 2022 to study the "Effect of organic manures on growth, yield and quality of Beet root (Beta vulgaris L.)" cv. Crimson globe in saline and alkaline soils, at Horticulture farm , Kulbhaskar Ashram Post Graduate College Prayagraj .The experiment was laid out in a randomized block design with three replicated 10 treatments viz., T1: FYM (100%), T2: Vermicompost (100%), T3: Poultry manure (100%), T4, Neem cake (100%), T5: FYM (50%) + Vermicompost (50%) , T6: FYM (50%) + Poultry manure (50%) , T7: FYM (50%) + Neem cake (50%),T8: Vermicompost (50%)+ Poultry manure (50%) T9, Poultry manure (50%)+ Neem cake (50%), T10, Control. The data were recorded on days required for germination of seedlings, plant height (cm), no of leaves per plant, specific leaf weight (g cm-2), leaf area (cm-2), root length (cm), root diameter (cm), root to shoot ratio, root yield per plot (kg plot-1), root yield per ha (t ha-1), harvest index (%).The early germination was recorded in poultry manure (100%) and it was at par with FYM (50%) + vermicompost (50%) and vermicompost (100%). The highest plant height and no of leaves was recorded with poultry manure (100%) which was at par with FYM (50%) + poultry manure (50%). The highest specific leaf weight, crop growth rate, net assimilation rate and leaf area were recorded with poultry manure (100%). The highest relative growth rate was recorded with vermicompost (100%). The highest FYM (50%) + vermicompost (50%) . Among the yield parameters the root length and harvest index were maximum with FYM (50%) + vermicompost (50%), where as root diameter was maximum with FYM (50%) + vermicompost (50%), . The highest root yield was recorded with FYM (50%) + vermicompost (50%), which was at par with vermicompost (100%). The highest root: shoot ratio was recorded with FYM (50%) + vermicompost (50%) followed by vermicompost (100%).

Keywords : *Beetroot, organic manures, growth, yield*

INTRODUCTION

Beetroot (*Beta vulgaris* L.), also called as garden beet or table beet, is one of the major root vegetable belongs to the family Chenopodiaceae along with spinach, palak, swiss chard, parsley, celery and it has chromosome number of 2n=18.

Beet originated in Western Europe and North Africa where they were grown to feed both humans and livestock. This crop is a biennial grown as a cool season annual. It is grown in northern and southern parts of India. It is grown in almost all states of India but in small scale only. It produces green tops and a swollen root used both as vegetable and salad. It is highly productive and usually free from pests and diseases (Ado, 1999). It is a rich source of protein, carbohydrate, calcium, phosphorous and vitamin C, hence it is an ideal vegetable for health conscious people (Deuter and Grundy, 2004). Red color of roots is due to presence of betanine pigment. It has several medicinal properties and helps in reduction of cardiovascular diseases and peripheral vascular diseases. Organic farming is not mere non-chemical agriculture but it is a system integrating relationships between soil, plant, water, soil micro flora and fauna. Organic farming aims in creating a healthy soil, helps in proper energy flows in soil, crop, water, environment while the plant systems keeps biological life cycle alive and helps in sustaining considerable levels in yield (Lampkin, 1990). Several attempts have been made to increase yield potential of bulb and root crops, but they are concerned with use of inorganic fertilizers which results in depletion of soil fertility and soil health. Farm yard manure being bulky organic material, releases the soil compactness and improves the aeration in addition to the supply of essential plant nutrients and organic matter and increase soil microbial establishment along with accumulation of excess humus content. It acts directly for increasing crop yield by accelerating the respiratory process through cell permeability or by hormones through growth action. It supplies nitrogen, phosphorus and sulphur in available form to the plants through biological decomposition. Indirectly it improves the physical properties of soil such as aggregation, aeration, permeability and water holding capacity (Chandramohan, 2002).

MATERIALS AND METHODS

A field experiment was conducted during *rabi*, 2021 to 2022 to study the "Effect of organic manures on growth, yield and quality of Beet root (*Beta vulgaris* L.)" cv.Crimson globe in alkaline and saline soils, at Horticulture farm , Kulbhaskar Ashram Post Graduate College Prayagraj . The experiment was laid out in a randomized block design with three replicated 10 treatments *viz*., T_1: FYM (100%), T_2: Vermicompost (100%), T_3: Poultry manure (100%), T_4, Neem cake (100%), T_5: FYM (50%) + Vermicompost (50%) , T_6: FYM (50%) + Poultry manure (50%) , T_7: FYM (50%) + Neem cake (50%),T_8: Vermicompost (50%)+ Poultry manure (50%) T_9, Poultry manure (50%)+ Neem cake (50%), T_{10}, Control. The data were recorded on days required for germination of seedlings, plant height (cm), number of leaves per plant, specific leaf weight (g cm^{-2}), root length (cm), root diameter (cm), root to shoot ratio, root yield per plot (kg $plot^{-1}$), root yield per ha (t ha^{-1}), harvest index (%).

The plant height was measured from ground level to the tip of longest leaf at 25, 50 days after sowing and at harvest from five tagged plants and their mean was worked out. Total number of leaves counted for five randomly selected plants and counted at 25, 50 days after sowing and at harvest and their mean was worked out.

The specific leaf weight on all the sampling days was calculated by using the formula

SLW = Leaf dry weight / Leaf area

RESULTS AND DISCUSSION

Plant height (cm)

The plant height was significantly increased by the application of poultry manure (100%) followed by FYM (50%) + poultry manure (50%) at different stages of plant growth. The results are presented in Table 2. At 25 DAS the highest plant

height (19.39 cm) was recorded in T_5 with Farm yard manure + Vermicompost and it was followed by T_7 (18.59 cm) with Farm yard manure Neem cake, T_8 (17.56 cm) with Vermicompost + Poultry Manure and T_2 (16.49 cm) with Vermicompost. The lowest plant height was recorded in T_{10} (13.47 cm) under control condition. At 50 DAS the highest plant height (36.77 cm) was recorded in T_5 with Farm yard manure + Vermicompost and it was followed by T_7 (31.40 cm) with Farm yard manure + Neem cake, T_8 (29.48 cm) with Vermicompost + Poultry Manure and T_2 (28.46 cm) with Vermicompost. The lowest plant height was recorded in T_{10} (22.50 cm) under control condition. The plant height of beet root was significantly affected in all stages of crop growth with the application of organic manures. Among different organic manures soil application of poultry manure (100%) improved plant height at all the growth stages. Nitrogen being a major element has a profound effect on plant growth and development and as a constituent of proteins and also its effect on production of plant hormones in plants. The increased plant height with the application of poultry manure (100%) may be attributed to their higher N content of (1.18%). The positive effect of organic manure on plant height could be due to the contribution made by manure to fertility status of the soils as the soils were low in organic carbon content. Manure when decomposed increases both macro and micro nutrients as well as enhances the physico-chemical properties of the soil. This could have led to its high vegetative growth.The results are in support with findings of Tiamiyu *et al.,* 2012 in okra. Though the green manure contains high 'N' content (1.80%) than applied poultry manure (1.18%) it could not record maximum plant height over poultry manure (100%) may be because of slow release of nutrient availability. Okokoh and Bisong (2011) reported similarly that application of 10 to 15 t/ha of poultry manure resulted in increased height of amaranthus plants.

Table - 1 : Effect of Different Organic Manures on Plant Height (cm) of Beet Root at Different Stages of Crop Growth

Symbol	Treatments	Plant hight (cm)		
		25 DAS	50 DAS	At Harvest
T_1	Farm yard manure (100%)	15.49	24.43	26.42
T_2	Vermicompost (100%)	16.49	28.46	30.48
T_3	Poultry manure (100%)	14.49	23.38	25.39
T_4	Neem cake (100%)	16.32	26.44	28.53
T_5	Farm yard manure(50%) + Vermicompost (50%)	19.39	36.77	36.79
T_6	Farm yard manure(50%) + Poultry manure (50%)	15.62	25.42	27.43
T_7	Farm yard manure(50%) + Poultry manure (50%)	18.59	31.40	32.48
T_8	Farm yard manure(50%) + Neem cake (50%)	17.56	29.48	31.71
T_9	Vermicompost(50%) + Poultry manure (50%)	16.34	27.48	29.49
T_{10}	Poultry manure(50%) + Neem cake (50%)	13.47	22.50	24.50
CDat5%		**0.195**	**0.111**	**0.217**
SE (m)±		**0.065**	**0.037**	**0.072**
C.V.		**0.688**	**0.334**	**0.428**

Number of leaves

Number of leaves were significantly affected by the application of organic manures their combinations at different stages of plant growth. The results are presented in Table 3. At 25 DAS, maximum number (14.45 cm) of leaves per plant was recorded in T_5 with Farm yard manure + Vermicompost and it was followed by T_7 (13.21 cm) with Farm yard manure + Neem cake, T_8 (12.48 cm) with Vermicompost + Poultry Manure and T_2 (11.65 cm) with Vermicompost. The lowest number of leaves was recorded in T_{10} (5.44 cm) under control condition. At 50 DAS, the heighest number of leaves (21.45 cm) was recorded in T5with Farm yard manure + Vermicompost and it was followed by T_7 (20.43 cm) with Farm yard manure + Neem cake, T_8 (19.49 cm) with Vermicompost + Poultry Manure and T_2 (17.46 cm) with Vermicompost. The lowest number of leaves was recorded in T_{10}(12.45 cm) under control condition.At harvest the (24.45 cm) was recorded in T_5 with farm yard manure + Vermicompost it was followed by T_7 (23.54 cm) with Farm yard manure + Neemcake, T8 (22.64 cm) with Vermicompost + Poultry Manure and T_2(21.44 cm) with Vermicompost which was significantly superior to all other treatments. The lowest was recorded in T_{10}(15.44 cm). Application of organic manures to the soil, physical condition of the soil will be improved by the better aggregation of soil particles (Samandasingh *et al.,* 1988). These aggregates effects the soil fertility and often determine the retention and movement of water, diffusion of gases, growth and development of roots in the soil which contributed to the growth of the plant (Ghildyal and Gupta, 1991 and Arulmozhian,1996). Since, poultry manure (100%) contains high amount of major nutrients comparative to the other organic nutrients used as treatments probably which helps for the proper growth and development of vegetative structures (i.e., leaves). The results were in conformity with findings of Tiamiyu *et al.,* 2012 in okra. Okokoh and Bisong (2011) reported similar findings that application of 10 to 15t/ha of poultry manure enhanced the performance of Amaranthus in a study in Calabar, Nigeria. Mean number of leaves per plant were found to be significantly influenced by poultry manure application in amaranthus.

Table - 2 : Effect of Different Organic Manures on Number of Leaves Per Plant of Beet Root at Different Stages of Crop Growth

Symbol	Treatments	Number of leaves/Plant		
		25 DAS	50 DAS	At Harvest
T_1	Farm yard manure (100%)	7.43	14.50	17.48
T_2	Vermicompost (100%)	11.65	17.82	21.44
T_3	Poultry manure (100%)	6.50	13.43	16.42
T_4	Neem cake (100%)	9.49	16.39	19.49
T_5	Farm yard manure(50%) + Vermicompost (50%)	14.45	21.45	24.45
T_6	Farm yard manure(50%) + Poultry manure (50%)	8.53	15.44	18.43
T_7	Farm yard manure(50%) + Poultry manure (50%)	13.21	20.43	23.54
T_8	Farm yard manure(50%) + Neem cake(50%)	12.48	19.49	22.64
T_9	Vermicompost(50%) + Poultry manure(50%)	10.42	17.46	20.45
T_{10}	Poultry manure(50%) + Neem cake (50%)	5.40	12.45	15.44
CDat5%		**0.106**	**0.070**	**0.062**
SE (m)±		**0.036**	**0.023**	**0.021**
C.V.		**0.618**	**0.239**	**0.180**

Specific leaf weight (mgcm^{-2})

The specific leaf weight recorded during the growth periods of 25 DAS, 50 DAS and harvesting stage were statistically analysed and presented in table.4. The specific leaf weight was low during the early stage (25DAS) of the plant growth but it increased gradually with the advancement of age. At harvest, (18.47 g) was recorded in T_5 with farm yard manure + Vermicompost it was followed by T_7 (17.47 g) with Farm yard manure + Neemcake, T_8 (16.46 g) with Vermicompost + Poultry Manure and T_2 (15.46 g) with Vermicompost which was significantly superior to all other treatments. The lowest was recorded in T10 (9.44 g).

Table - 3 : Effect of Different Organic Manures on Specific Leaf Weight (mg Cm^{-2}) of Beet Root at Different Stages of Crop Growth

Symbol	Treatments	Mean
T_1	Farm yard manure (100%)	11.45
T_2	Vermicompost (100%)	15.46
T_3	Poultry manure (100%)	10.53
T_4	Neem cake (100%)	13.47
T_5	Farm yard manure(50%) + Vermicompost (50%)	18.47
T_6	Farm yard manure(50%) + Poultry manure (50%)	12.46
T_7	Farm yard manure(50%) + Neem cake (50%)	17.47
T_8	Farm yard manure(50%) + Poultry manure (50%)	16.46
T_9	Vermicompost(50%) + Poultry manure (50%)	14.45
T_{10}	Control	9.44
CDat5%		**0.051**
SE (m)±		**0.017**
C.V.		**0.213**

CONCLUSIONS

The following conclusions can be drawn from the experiment's findings: organic manure had beneficial effects on Bee root growth, yield and quality. The treatment with T_5 (Farm yard manure + Vermicompost) improved maximum growth and provided greater yield treatment was also found in maximum quality parameters.

REFERENCES

1. Murugan, 2000. Integrated nutrient management in baby corn. Indian Journal of Horticulture. 63(1): 98-100.
2. Indumathi, S. 2000. Integrated nutrient management in radish (Raphanus sativus L.) M.Sc. thesis submitted to Acharya N. G. Ranga Agricultural University, Hyderabad
3. Chezhiyan, N., Saraswathi, S. and Vasumathi, R. 2002. Studies on organic manures, biofertlizers and plant density on growth, yield and alkaloid content of bhumyamalaki (Phyllanthus amarus Schum. and Thom). South Indian Hart., 51 (1-6): 96-101
4. Bodkhe, V.A. 2006. Effect of various organic manures on growth, yield and quality of radish. M.Sc. (Agri.) Thesis, submitted to Dr. PDKV, Akola (M.S.), India.

5. Choudhary, M.K. and Atul Chandra* 2006. Effect of integrated nutrient management on yield and yield attributing characters in okra and succeeding crop radish. Indian Journal of Arid Horticulture, 1 (1): 25-27.

6. Verma , Poonam and Pandey , S.N. (2016) Effect of integrated nutrient management in alluvial soil on growth and biochemical responses of radish . J. Biol . Chem . Research 33 (1) : 34-39

7. Vijayakumari , B. , Hiranmaiyadav , R. and Sowmya , M. (2009) A study on the effect of few eco - friendly manures on the growth attributes of carrot (Daucus carota L.) Journal of Environmental Science & Engineering . 51 (1) : 13-16 .

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DETERMINATION OF BACTERIAL QUALITY OF RAW MILK SHAHIWAL (COW) AS INFLUENCED BY DIFFERENT MILKING TIME

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ABSTRACT

The present experiment was conducted Determination of bacterial quality of raw milk shahiwal (cow) as influenced by different milking time was carried out at the period of experiment was one month (January to April, 2022). Milk was collected at the Mini Dairy Farm Rajola Livestock Production and Management (Unit), Department of Natural resource management (NRM), Faculty of Agriculture, Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot – Satna (Madhya Pradesh). to find out the comparative chemical qualities of raw milk of shahiwal cow for ten days as replication different parameter were subject to statistical analysis applying the technique of analysis of variance (f-test) the most widely used method for determining protein content by kjeldahi method for nitrogen determination since nitrogen is a characteristic can be finding. In view of the findings and results presented above, it may be concluded that the chemical quality of milk of Evening was superior to morning milk, due to higher protein. Specific gravity, fat content, lactose, total solid and solid not fat and lower ash and water content in morning milk.

Keywords : *Sahiwal, milking time, and raw milk.*

INTRODUCTION

Milk is defined as the whole, fresh, clean, lacteal secretion obtained by complete milking of one or more healthy animals excluding that obtained within fifteen days before or five days after calving or such periods as may be necessary to render milk practically colostrum free and containing the minimum prescribed percentage of milk fat (3.5%) and solids not fat (8.5%) (Goff and Hill, 1993). Milk, if present in its natural form has high food value. It supplies nutrients like good quality proteins, fat, carbohydrates, vitamins and minerals in significant amount than any other single food (Neumann *et al.,* 2002). Besides its general need for human health, milk proteins supply those amino acids which are needed for proper growth of adults and infants (Espinosa *et.al,*1992). Buffalo and cow milk contains 7.6 and 4.5% fat, 3.8 and 3.8%

protein, 4.9 and 4.9% lactose 0.78 and 0.72% ash, 17 and 13.9% total solids respectively (Khan *et.al.,* 2005). The quality of raw milk in India is relatively poor and the initial bacterial count is high. This is due to the fact that milk is a quickly perishable commodity on account of unhygienic milking, storage and handling due to the ambient temperature prevailing in most part of the country, which is quite high during large part of the year which reduces the keeping quality. It is, therefore, essential to promote hygienic milk production. Despite various constraints, India has become an important exporter of milk products. The Indian dairy industries have invested huge amounts to upgrade the quality and hygienic system so that the quality of milk products being exported attains the international standards. The industries have in fact created a special position for itself in the international market byway of providing consistently good quality products at a competitive price. The demands for acidcum-heat coagulated milk products viz. chhana have increased consistently during the last decade but its shelf-life is a major constraint, as it is limited to 1-2 dalys at ambient temperatures, and 3-5 days at refrigeration temperatures. Hence, there is an urgent need to further improve the self-life of chhana at refrigeration temperatures by inhibiting the growth of spoilage organisms and arresting biochemical changes through use of preservatives. (Yadav and Gupta, 2013). The buffering of milk influences many of its physico-chemical properties (by controlling pH) during processing, e.g. heat and ethanol stability, rennet coagulation time, firmness and syneresis of renneted milk gels, rate of pH change in cheese, the pH of cheese at the end of manufacture and the subsequent pH changes during ripening. Acid-base equilibria and buffer action have been the subject of many studies (van Slyke, 1922; Jorgensen, 1955; Gold, 1956; Edsall and Wyman, 1958; Bates, 1964). The pH of bovine milk is commonly stated to be between 6.5 and 6.7, with 6.6 being the most usual value. However, it should be emphasized that this value applies only at temperatures near 25°C. The pH of milk is more dependent on temperature than that of buffers, such as phosphate, since milk is a complex buffer system and variations in temperature cause many changes. Differences in pH and buffering between individual lots of fresh milk reflect compositional variation. The pH of colostrum is lower, e.g. pH 6.0 (Mcintyre *et al.,* 1952) . The Sahiwal is the heaviest milker of all Zebu breeds and display a well-developed udder. Sahiwals demonstrate the ability to sire small, fast-growing calves and are noted for their hardiness under unfavourable climatic conditions. Other characteristics include (Pandey, K. P., *et al.,* 2016). Minor Milk Constituents: There are three types of phospholipids in milk, cephalic, lecithin and sphingomylin. Lecithin contributes to the flavor to milk and other dairy products . Phospholipids stabilize the milk fat emulsion as it is an excellent emulsifying agent. Cholesterol present in fat solution and the part of the fat globule membrane. The second minor constituent of milk includes fat - soluble and water - soluble pigments . Fat soluble pigments include carotene and xanthophylls and water - soluble pigment includes riboflavin. The important milk enzymes are lipase, amylase, protease, phosphatise, catalyse and peroxidise. More than 25 vitamins have been reported to be present in milk most of which cannot be produced within the body and therefore need to be provided in the diet (few milligrams or micrograms per day). Vitamin D can be obtained by the action of sunlight on the skin and B vitamin can be made from tryptophan amino acids. Fat soluble vitamins includes vitamin A (Retinol and - carotene), vitamin D (Calciferol), vitamin E (Tocopherol) and vitamin K. Water soluble vitamins include B complex vitamins , e.g. Thiamine (B1) , Riboflavin

(B2) , Niacin (B3) , etc. and small quantities of vitamin C (ascorbic acid) is present in milk which can be destroyed by souring , oxidation and heat , (Bendicho *et.al,*, 2002) . 4 Many trace elements that are essential for growth are present in milk that includesCalcium, sodium, potassium, phosphorus, zinc, cobalt, iodine, iron etc (Harding, 1999). Mesophilic Bacteria : The micro - organisms growing optimally at 30 °C to 32 °C are designated as ' mesophilic ' (Yadav *et al.,* 1993) . Thermophilic Bacteria : In dairy industry , the term applies to those bacteria , which can not only survive but also grow at pasteurization temperatures . These bacteria can readily grow at 55 °C and most of them have an upper limit of growth at about 70 °C. Although some facultative thermophiles may grow at 37 °C or lower in standard plate count analysis, the standard method of enumerating this group of organisms is to incubate agar plate at 55 °C, (Yadav *et al.,* 1993). Psychrotrophic Bacteria Enclosed pipeline milk systems, better sanitary design of equipment, cleaner cows, and more effective “clean in place” systems have provided the opportunity for farms to produce raw milk with less microbial contamination. Rapid cooling of raw milk before the bulk tank with inline plate coolers has reduced the growth of contaminating bacteria. Rapid cooling and refrigerated storage of raw milk has favored the growth of psychrotrophic bacteria in raw milk. Nonsporeforming psychrotrophic bacteria, particularly Pseudomonas spp., are killed by HTST pasteurization. Pseudomonas spp. would need to grow to relatively high numbers (e.g., 1×10) in raw milk before pasteurization to produce an off-flavor directly. Psychrotrophic gram-negative bacteria produce heat-stable proteases and lipases, and a high level of these organisms in raw milk could contribute heat-stable enzymes that may produce off-flavor issues later during the shelf life of pasteurized milk. Postpasteurization contamination of milk with psychrotrophic gram-negative bacteria has typically limited shelf life of conventionally pasteurized milk to 14 to 17 days. Today, improved postpasteurization milk handling and packaging conditions have eliminated the gram-negative spoilage problem, and has revealed the presence of a smaller number of heat-resistant psychrotrophic gram-positive bacteria such as Bacillus spp. and Microbacter (Ralyea *et al.,* 1998; Fromm and Boor, 2004).

MATERIALS AND METHODS

DURATION AND PLACE OF STUDY -

The present experiment was conducted Determination of bacterial quality of raw milk shahiwal (cow) as influenced by different milking time was carried out at the period of experiment was one month (January to April, 2022). Milk was collected at the Mini Dairy Farm Rajola Livestock Production and Management (Unit), Department of Natural resource management (NRM), Faculty of Agriculture, Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot – Satna (Madhya Pradesh).

COLLECTION OF SAMPLE

The objective was to find out the comparative chemical qualities of raw milk of goat and sheep for three animal each viz. shahiwal cow for ten days as replication different parameter were subject to statistical analysis applying the technique of analysis of variance (f-test) the most widely used method for determining protein content by kjeldahi method for nitrogen determination since nitrogen is a characteristic can be finding.

Analysis of The Milk Samples

Organoleptic tests were performed by a panel of expert judges, Department of Natural resource management through visually, nasally and lingually to evaluate the color, flavor, texture and appearance of collected raw milk samples. Specific gravity was determined using Quevenne's

lactometer, cylinder and floating Dairy thermometer according to the procedure described by Aggarwala and Sharma (1961). Acidity test (%) was performed by titrating milk samples with 0.1N NaOH solutions according to the method described by Aggarwala and Sharma (1961). Fat test (%) was done according to Gerber Fat Test method and protein test (%) was performed by formal titration method according to Horwitz (1975). Total solids (TS) and solids-not-fat (SNF) (%) were calculated by mathematical formula of Eckles *et.al,*(1951). Ash content (%) was determined by evaporation method and lactose content (%) was determined by calculation method. Total viable count (cfu/ml) and coliform count (cfu/ml) were determined as per recommended by the American Public Health Association, 1960.

DISTRIBUTION AT DIFFERENT MILKING TIME OF SHAHIWAL COW

- Morning
- Evening
- Cow no : 88, 101 and 115

RESULTS AND DISCUSSION

(1) Protein

Table 1.0 and fig. 1.0 furnish the data on protein percentage in raw milk of cow. The results obtained showed that Morning and Evening registered mean protein percentage as 3.517, 3.578, 3.661 (overall 3.676) and 3.676, 3.738, 3.819 (overall 3.744), respectively. The difference in the values due to animals was significant. Due to replication, the differences was non- significant.

Table - 1.0 : Protein (%) in Morning and Evening Milk

Replication		Morning				Evening			
		C1	C2	C3	Mean	C1	C2	C3	Mean
R1		3.43	3.58	3.62	3.54	3.60	3.75	3.79	3.71
R2		3.54	3.57	3.64	3.58	3.69	3.72	3.79	3.73
R3		3.64	3.53	3.65	3.61	3.80	3.69	3.81	3.77
R4		3.49	3.61	3.64	3.58	3.65	3.77	3.80	3.74
R5		3.51	3.60	3.55	3.55	3.68	3.77	3.71	3.72
R6		3.49	3.62	3.65	3.59	3.63	3.76	3.79	3.73
R7		3.49	3.53	3.66	3.56	3.67	3.71	3.84	3.74
R8		3.54	3.61	3.76	3.64	3.69	3.76	3.91	3.79
R9		3.49	3.59	3.75	3.61	3.65	3.75	3.91	3.77
R10		3.55	3.54	3.69	3.59	3.70	3.70	3.84	3.75
Range	Max	**3.64**	**3.62**	**3.76**	**3.80**	**3.80**	**3.77**	**3.91**	**3.79**
	Min	**3.43**	**3.53**	**3.55**	**3.60**	**3.60**	**3.69**	**3.71**	**3.71**
	Mean	**3.517**	**3.578**	**3.661**	**3.676**	**3.676**	**3.738**	**3.819**	**3.744**
		Result	S. Ed. (±)	C.D. at 5%		**Result**	S. Ed. (±)	C.D. at 5%	
Replication		NS	0.024	0.050		NS	0.78	1.63	
Cow		S	0.043	0.091		S	1.42	2.98	

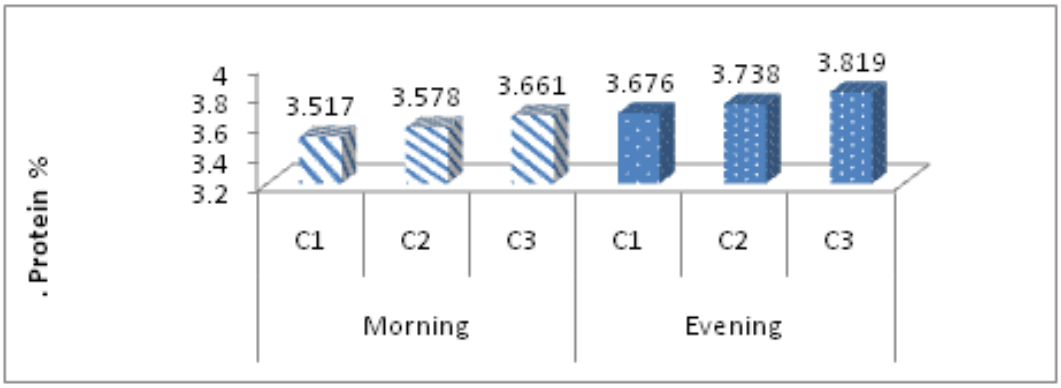

Fig. - 1.0 : Protein (%) in Morning and Evening Milk

(2) Specific gravity (%)

Table 2.0 and fig. 2.0 furnish the data on specific gravity percentage in raw milk of Morning and Evening. The results obtained showed that Morning and Evening registered mean specific gravity percentage as 1.0278,6.3607 and 1.8861 (overall 1.886) and 1.098, 1.0618 and 1.0172 (overall 1.059), respectively. The difference in the values due to animals was significant. Due to replication, the differences was non –significant in Morning and Evening milk.

Table - 2.0 : Specific Gravity (cc) in Morning and Evening Milk

Replication		Morning				Evening			
		C1	C2	C3	Mean	C1	C2	C3	Mean
R1		1.04	1.04	1.88	1.32	1.11	1.07	1.01	1.06
R2		1.02	0.99	1.89	1.30	1.09	1.06	1.02	1.05
R3		1.03	1.04	1.89	1.32	1.10	1.08	1.03	1.07
R4		1.03	1.01	1.90	1.31	1.10	1.05	1.03	1.06
R5		1.02	1.03	1.88	1.31	1.09	1.05	1.03	1.06
R6		1.02	0.99	1.89	1.30	1.09	1.06	1.01	1.05
R7		1.05	1.06	1.90	1.34	1.12	1.06	1.03	1.07
R8		1.03	1.00	1.88	1.30	1.10	1.06	1.01	1.05
R9		1.03	1.03	1.89	1.31	1.10	1.07	1.02	1.06
R10		1.02	1.02	1.87	1.30	1.09	1.07	1.00	1.05
Range	Max	**1.050**	**1.060**	**1.902**	**1.34**	**1.12**	**1.08**	**1.03**	**1.07**
	Min	**1.015**	**0.985**	**1.865**	**1.30**	**1.09**	**1.05**	**1.00**	**1.05**
	Mean	**1.028**	**1.020**	**1.886**	**1.311167**	**1.0988**	**1.0618**	**1.0172**	**1.0593**
		Result	S. Ed. (±)	C.D. at 5%		**Result**	S. Ed. (±)	C.D. at 5%	
Replication		S	0.006	0.012		NS	0.00	0.01	
Cow		S	0.010	0.022		S	0.01	0.02	

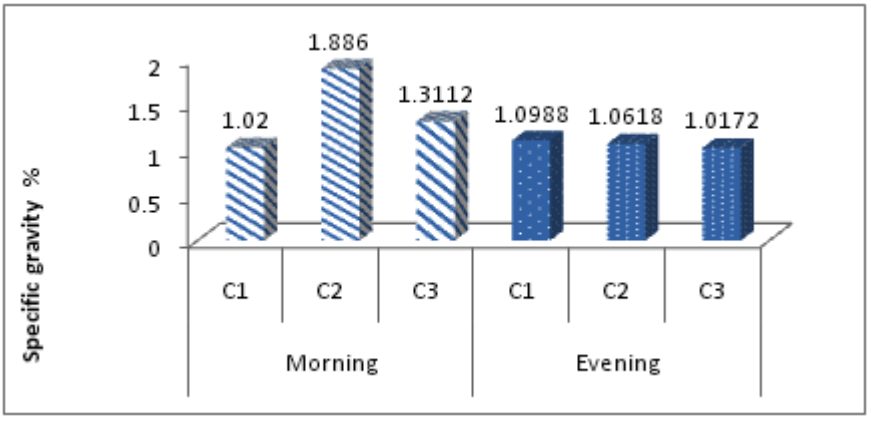

Fig. - 2.0 : Specific gravity (%)in Morning and Evening Milk

(3) Fat (%)

The data on fat percentage in raw milk of Morning and Evening . The results obtained showed that Morning and Evening registered mean fat percentage as 3.565, 3.525, 3.596 (overall 3.562) and 3.565, 3.525, 3.596 (overall 3.562), respectively. The difference in the values due to animals was significant. Due to replication, the differences was non –significant in both , Morning and Evening milk (Table 3.0 and fig. 3.0).

Table - 3.0 : Fat (%) in Morning and Evening Milk

Replication		Morning				Evening			
		C1	C2	C3	Mean	C1	C2	C3	Mean
R1		3.00	2.07	2.83	2.63	3.17	2.24	3.00	2.80
R2		3.60	2.63	3.16	3.13	3.75	2.78	3.31	3.28
R3		3.16	3.00	3.36	3.17	3.32	3.16	3.52	3.33
R4		3.33	3.46	3.43	3.41	3.49	3.62	3.59	3.57
R5		3.13	3.43	3.33	3.30	3.30	3.60	3.50	3.47
R6		3.10	3.26	3.33	3.23	3.25	3.41	3.48	3.38
R7		3.02	3.36	3.46	3.28	3.20	3.54	3.64	3.46
R8		4.10	3.70	3.83	3.88	4.25	3.85	3.98	4.03
R9		3.80	4.30	3.96	4.02	3.96	4.46	4.12	4.18
R10		3.80	4.43	3.66	3.96	3.96	4.59	3.82	4.12
Range	Max	**4.10**	**4.43**	**3.96**	**4.02**	**4.25**	**4.59**	**4.12**	**4.18**
	Min	**3.00**	**2.07**	**2.83**	**2.63**	**3.17**	**2.24**	**3.00**	**2.80**
	Mean	**3.404**	**3.364**	**3.435**	**3.401**	**3.565**	**3.525**	**3.596**	**3.562**
		Result	S. Ed. (±)	C.D. at 5%		**Result**	S. Ed. (±)	C.D. at 5%	
Replication		S	0.139	0.292		S	0.14	0.29	
Cow		NS	0.254	0.534		NS	0.25	0.53	

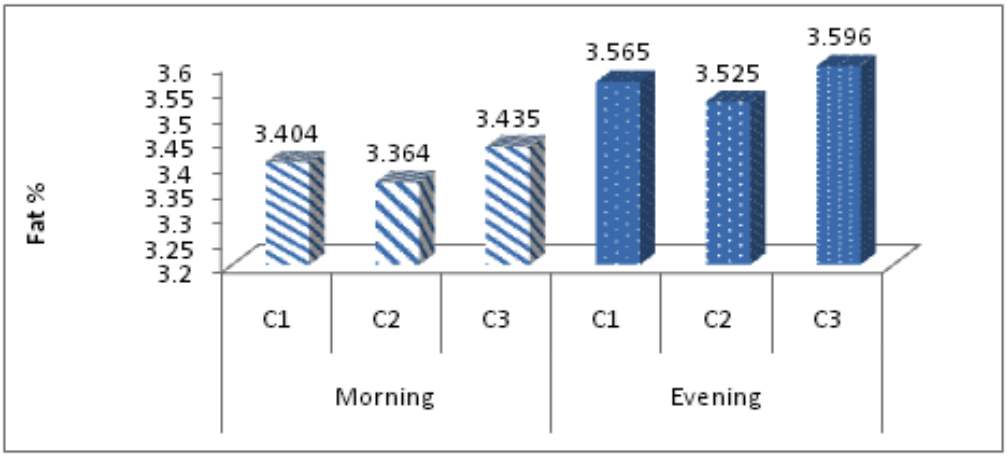

Fig. - 3.0 : Fat (%) in Morning and Evening Milk

(4) Lactose (%)

Table 4.0 and fig. 4.0 presents the data on lactose percentage in raw milk of Morning and Evening. The results obtained showed that Morning and Evening registered mean lactose percentage as 4.035, 4.02, 3.965 (overall 4.006) and 4.183, 4.168, 4.113 (overall 4.154), respectively. The difference in the values due to animals as well as due to replication were significant, Higher lactose content was found in evening milk.

Table - 4.0 : Lactose (%) in Morning and Evening Milk

Replication		Morning				Evening			
		C1	C2	C3	Mean	C1	C2	C3	Mean
R1		4.00	3.95	3.95	3.97	4.16	4.11	4.11	4.13
R2		4.10	4.10	3.95	4.05	4.23	4.23	4.08	4.18
R3		4.10	4.05	3.95	4.03	4.25	4.20	4.10	4.18
R4		4.05	4.05	4.00	4.03	4.20	4.20	4.15	4.18
R5		4.10	4.10	4.05	4.08	4.26	4.26	4.21	4.24
R6		4.05	4.05	4.00	4.03	4.18	4.18	4.13	4.16
R7		4.10	4.10	4.05	4.08	4.27	4.27	4.22	4.25
R8		3.90	3.90	3.85	3.88	4.04	4.04	3.99	4.02
R9		4.05	4.00	4.00	4.02	4.20	4.15	4.15	4.17
R10		3.90	3.90	3.85	3.88	4.04	4.04	3.99	4.02
Range	Max	**4.10**	**4.10**	**4.05**	**4.08**	**4.27**	**4.27**	**4.22**	**4.25**
	Min	**3.90**	**3.90**	**3.85**	**3.88**	**4.04**	**4.04**	**3.99**	**4.02**
	Mean	**4.035**	**4.02**	**3.965**	**4.007**	**4.183**	**4.168**	**4.113**	**4.157**
		Result	S. Ed. (±)	C.D. at 5%		**Result**	S. Ed. (±)	C.D. at 5%	
Replication		S	0.012	0.025		S	0.01	0.03	
Cow		S	0.022	0.046		S	0.02	0.05	

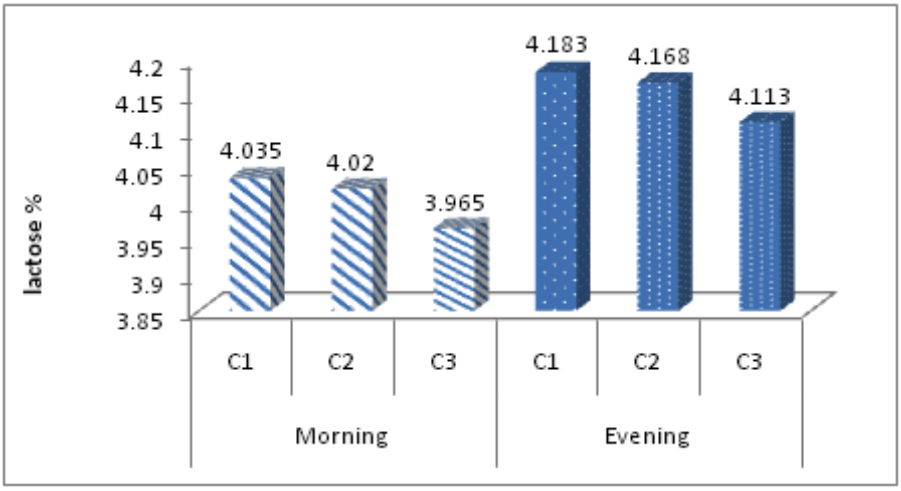

Fig. - 4.4 : Lactose (%) in Morning and Evening Milk

(5) Ash (%)

Table 5.0 and fig. 5.0 furnish the data on ash percentage in raw milk of Morning and Evening. The results obtained showed that Morning and Evening registered mean ash percentage as 0.674, 0.69, 0.706 (overall 0.677) and 0.70, 0.691 , 0.706 (overall 0.69), respectively. The difference in the values due to three animal each as well as due to replication were significant , Ash percentage was lower in evening milk.

Table - 5.0 : Ash (%) in Morning and Evening Milk

		Morning				Evening			
Replication		C1	C2	C3	Mean	C1	C2	C3	Mean
R1		0.66	0.67	0.67	0.67	0.70	0.69	0.70	0.70
R2		0.66	0.66	0.65	0.66	0.70	0.70	0.70	0.70
R3		0.66	0.70	0.64	0.67	0.69	0.67	0.71	0.69
R4		0.68	0.70	0.70	0.69	0.68	0.66	0.67	0.67
R5		0.68	0.68	0.66	0.67	0.71	0.71	0.73	0.72
R6		0.67	0.70	0.68	0.68	0.70	0.69	0.70	0.70
R7		0.65	0.67	0.62	0.65	0.71	0.71	0.72	0.71
R8		0.70	0.74	0.73	0.72	0.70	0.69	0.71	0.70
R9		0.73	0.73	0.70	0.72	0.70	0.69	0.71	0.70
R10		0.65	0.65	0.63	0.64	0.71	0.70	0.71	0.71
Range	Max	**0.73**	**0.74**	**0.73**	**0.72**	**0.71**	**0.71**	**0.73**	**0.72**
	Min	**0.65**	**0.65**	**0.62**	**0.64**	**0.68**	**0.66**	**0.67**	**0.67**
	Mean	**0.674**	**0.69**	**0.668**	**0.677333**	**0.7**	**0.691**	**0.706**	**0.699**
		Result	S. Ed. (±)	C.D. at 5%		**Result**	S. Ed. (±)	C.D. at 5%	
Replication		S	0.006	0.013		S	0.00	0.01	
Cow		S	0.011	0.024		S	0.01	0.01	

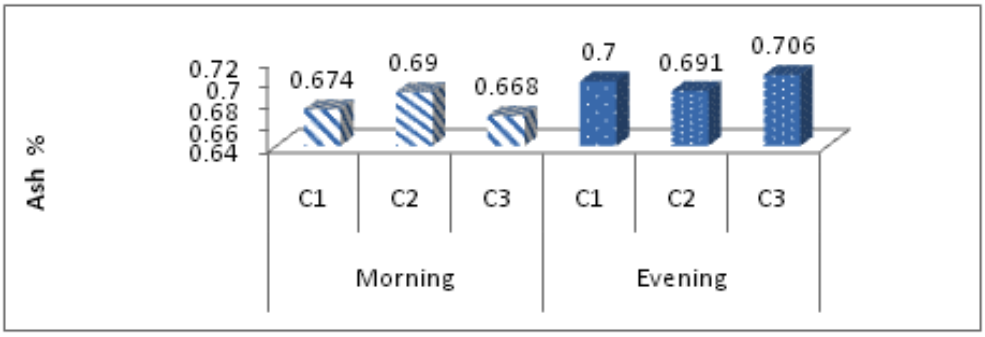

Fig. - 5.0 : Ash (%) in Morning and Evening Milk

(6) Total solid (%)

The data on total solid percentage in raw milk of Morning and Evening is presented in Table 6.0 and Fig 6.0 .The results contained in the Table showed that Morning and Evening registered mean total solid percentage as 12.531, 12.401 and 12.665 (overall 12.532) and 12.571, 12.442 and 12.706 (overall 12.573) respectively .The difference in these values to animals was found significant , whereas due to replication , the differences were non – significant, Total solid percentage was higher in evening milk.

Table - 6.0 : Total solids (%) in Morning and Evening Milk

Replication		Morning				Evening			
		C1	C2	C3	Mean	C1	C2	C3	Mean
R1		12.23	12.22	12.55	12.33	12.28	12.27	12.60	12.38
R2		12.45	12.36	12.45	12.42	12.48	12.39	12.48	12.45
R3		12.56	12.30	13.05	12.64	12.60	12.34	13.09	12.68
R4		12.98	12.83	13.05	12.95	13.02	12.87	13.09	12.99
R5		12.53	12.28	12.66	12.49	12.58	12.33	12.71	12.54
R6		12.46	12.28	12.48	12.41	12.49	12.31	12.51	12.44
R7		13.37	13.10	13.48	13.32	13.43	13.16	13.54	13.38
R8		12.31	12.20	12.41	12.31	12.34	12.23	12.44	12.34
R9		12.21	12.18	12.26	12.22	12.25	12.22	12.30	12.26
R10		12.21	12.26	12.26	12.24	12.25	12.30	12.30	12.28
Range	Max	**13.37**	**13.10**	**13.48**	**13.32**	**13.43**	**13.16**	**13.54**	**13.38**
	Min	**12.21**	**12.18**	**12.26**	**12.22**	**12.25**	**12.22**	**12.30**	**12.26**
	Mean	**12.531**	**12.401**	**12.665**	**12.532**	**12.572**	**12.442**	**12.706**	**12.573**
		Result	S. Ed. (±)	C.D. at 5%		**Result**	S. Ed. (±)	C.D. at 5%	
Replication		S	0.052	0.110		S	0.05	0.11	
Cow		S	0.095	0.200		S	0.10	0.20	

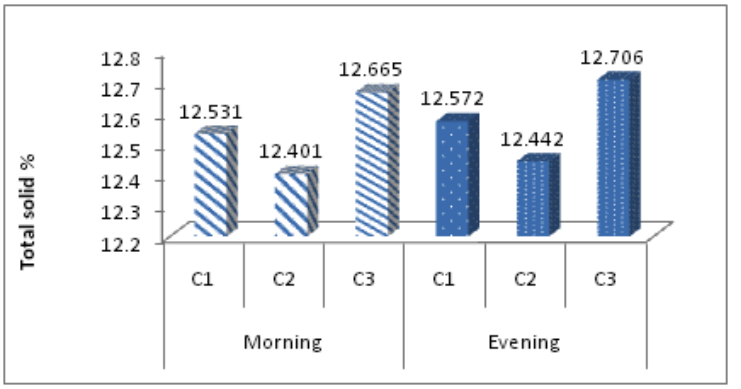

Fig. - 6.0 : Total solid (%) in Morning and Evening Milk (7) Water (%)

(7) Water (%)

The data on water percentage in raw milk of Morning and Evening. The results obtained showed that Morning and Evening registered mean water percentage as 87.469, 87.599, 87.335 (overall 87.467) and 87.51, 87.64, 87.376 (overall 87.50), respectively. The difference in the values due to animals has been found significant but due to replication, the result was non –significant, Water percentage was lower in evening milk.

Table - 7.0 : Water (%) in Morning and Evening Milk

Replication		Morning				Evening			
		C1	C2	C3	Mean	C1	C2	C3	Mean
R1		87.77	87.78	87.45	87.67	87.82	87.83	87.50	87.72
R2		87.55	87.64	87.55	87.58	87.58	87.67	87.58	87.61
R3		87.44	87.70	86.95	87.36	87.48	87.74	86.99	87.40
R4		87.02	87.17	86.95	87.05	87.06	87.21	86.99	87.09
R5		87.47	87.72	87.34	87.51	87.52	87.77	87.39	87.56
R6		87.54	87.72	87.52	87.59	87.57	87.75	87.55	87.62
R7		86.63	86.90	86.52	86.68	86.69	86.96	86.58	86.74
R8		87.69	87.80	87.59	87.69	87.72	87.83	87.62	87.72
R9		87.79	87.82	87.74	87.78	87.83	87.86	87.78	87.82
R10		87.79	87.74	87.74	87.76	87.83	87.78	87.78	87.80
Range	Max	**87.79**	**87.82**	**87.74**	**87.78**	**87.83**	**87.86**	**87.78**	**87.82**
	Min	**86.63**	**86.90**	**86.52**	**86.68**	**86.69**	**86.96**	**86.58**	**86.74**
	Mean	**87.469**	**87.599**	**87.335**	**87.46767**	**87.51**	**87.64**	**87.376**	**87.508**
		Result	S. Ed. (±)	C.D. at 5%		**Result**	S. Ed. (±)	C.D. at 5%	
Replication		S	0.052	0.110		S	0.05	0.11	
Cow		S	0.095	0.200		S	0.10	0.20	

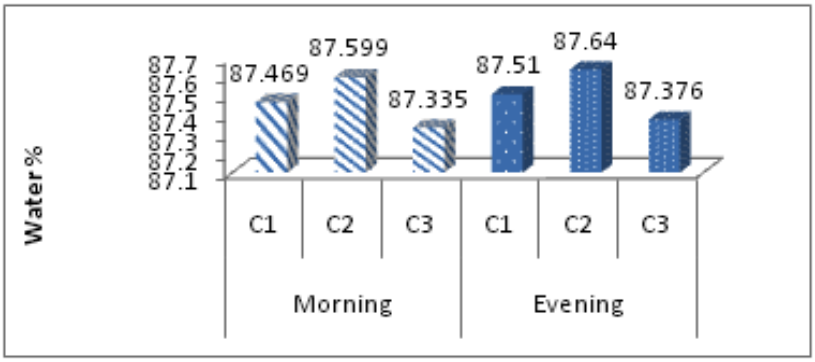

Fig. - 7.0 : Water (%) in Morning and Evening Milk

(8) Solid not fat (SNF) (%)

Table 8.0 and fig. 8.0 presents the data on solid not fat percentage in raw milk of Morning and Evening. The results presented in the Table showed that Morning and Evening registered mean SNF percentage as 8.307, 8.351 ,8.334 (overall 8.33) and 8.346 ,8.390, 8.373 (overall 8.370), respectively. The differences in these values due to animals were significant, whereas due to replication the differences were non – significant (Table 4.8.2 and 4.8.3). SNF content in evening milk was higher than that in Morning milk. The SNF content of the milk generally follow the variation of the fat content in milk.

Table - 8.0 : Solid not Fat (%)) SNF in Morning and Evening Milk

Replication		Morning				Evening			
		C1	C2	C3	Mean	C1	C2	C3	Mean
R1		8.57	8.43	8.48	8.49	8.62	8.48	8.53	8.54
R2		8.03	8.06	7.45	7.85	8.06	8.09	7.48	7.87
R3		8.38	8.58	8.39	8.45	8.42	8.62	8.43	8.49
R4		8.48	8.46	8.48	8.47	8.52	8.50	8.52	8.51
R5		8.23	8.25	8.14	8.21	8.28	8.30	8.19	8.25
R6		8.63	8.18	8.34	8.38	8.66	8.21	8.37	8.41
R7		8.50	8.51	8.75	8.59	8.56	8.57	8.81	8.65
R8		8.11	8.50	8.75	8.45	8.14	8.53	8.78	8.48
R9		7.90	8.28	8.45	8.21	7.94	8.32	8.49	8.25
R10		8.24	8.26	8.11	8.20	8.28	8.30	8.15	8.24
Range	Max	**8.63**	**8.58**	**8.75**	**8.59**	**8.66**	**8.62**	**8.81**	**8.65**
	Min	**7.90**	**8.06**	**7.45**	**7.85**	**7.94**	**8.09**	**7.48**	**7.87**
	Mean	**8.307**	**8.351**	**8.334**	**8.3307**	**8.347**	**8.391**	**8.3739**	**8.370**
		Result	S. Ed. (±)	C.D. at 5%		**Result**	S. Ed. (±)	C.D. at 5%	
Replication		S	0.094	0.197		S	0.09	0.20	
Cow		NS	0.171	0.360		NS	0.17	0.36	

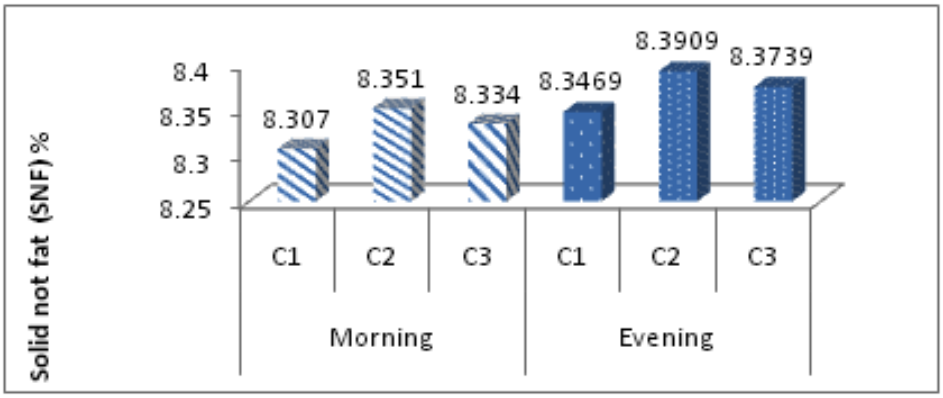

Fig. - 8.0 : Solid not fat (SNF) (%) in Morning and Evening Milk

(9) Per cent Acidity (%)

Table 9.0 and fig. 9.0 presents the data on acidity percentage in raw milk of Morning and Evening. The results presented in the Table showed that Morning and Evening registered mean SNF percentage as 0.155, 0.15 ,0148 (overall 0.151) and 0.145 ,0.148, 0.00 (overall 0.097), respectively. The differences in these values due to animals were significant, whereas due to replication the differences were non – significant.

Table - 9.0 : Acidity % in Morning and Evening Milk

Replication		Morning				Evening			
		C1	C2	C3	Mean	C1	C2	C3	Mean
R1		0.13	0.12	0.12	0.12	0.12	0.12	0.14	0.13
R2		0.16	0.15	0.16	0.16	0.15	0.16	0.17	0.16
R3		0.12	0.12	0.16	0.13	0.15	0.16	0.13	0.15
R4		0.16	0.14	0.14	0.15	0.15	0.14	0.17	0.15
R5		0.17	0.16	0.15	0.16	0.17	0.15	0.18	0.17
R6		0.16	0.16	0.15	0.16	0.14	0.15	0.17	0.15
R7		0.14	0.16	0.14	0.15	0.14	0.14	0.15	0.14
R8		0.17	0.16	0.17	0.17	0.15	0.17	0.18	0.17
R9		0.17	0.16	0.13	0.15	0.13	0.13	0.18	0.15
R10		0.17	0.17	0.16	0.17	0.15	0.16	0.18	0.16
Range	Max	**0.17**	**0.17**	**0.17**	**0.17**	**0.17**	**0.17**	**0.18**	**0.17**
	Min	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.12**	**0.13**	**0.13**
	Mean	**0.155**	**0.15**	**0.148**	**0.151**	**0.145**	**0.148**	**0.165**	**0.152**
		Result	S. Ed. (±)	C.D. at 5%		**Result**	S. Ed. (±)	C.D. at 5%	
Replication		S	0.006	0.012		S	0.01	0.01	
Cow		NS	0.010	0.021		S	0.01	0.02	

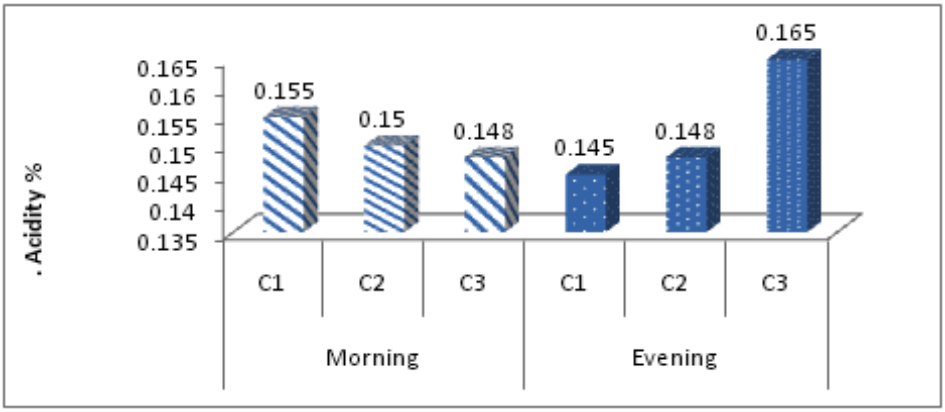

Fig. - 9.0 : Acidity (%) in Morning and Evening Milk

CONCLUSION

In view of the findings and results presented above, it may be concluded that the chemical quality of milk of Evening was superior to morning milk, due to higher protein. Specific gravity, fat content, lactose, total solid and solid not fat and lower ash and water content in morning milk.

REFERENCES

1. Goff, H.D. and A.R. Hill, (1993). Dairy Chemistry and Physics. In: Dairy Science and Technology Handbook I. Principles and Properties (Hui). VCH Publishers, New York, pp: 1-81.
2. Hardening F.,(1999). Milk quality (led). Chapman and Hall, London.102-104
3. Khan, B.B., M. Yaqoob, M. Riaz, M. Younas and A. Iqbal, (2005). Livestock Managment Manual. Department of Livestock Management, University of Agriculture, Faisalabad, Pakistan
4. Neumann, C.G., D.M. Harris and L.M. Rogers,(2002). Contribution of animal source foods in improving diet quality and function in children in the developing world. Nutr. Res., 22: 193-220.
5. Ralyea *et.al,* 1998 R. Ralyea, W. Weidmann, K.J. Boor, (1998). Bacterial tracking in a dairy production system using phenotypic and ribotyping methods J. Food Prot., 61 (1998), pp. 1336-1340
6. yadav et.al., (1993). Acomprehensive Dairy Microbioogy, Metropolitan phototype setters & printers ltd, 1-258.

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STUDIES ON THE EFFECT OF INTEGRATED NUTRIENT MANAGEMENT PRACTICES ON GROWTH, LEAF, YIELD AND QUALITY OF PALAK

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Field experiment were conducted to evaluated the Effect of Integrated Nutrient Management practices on growth of palak (Beta vulgaris var. bengalensis Hort.) During rabiseason 2021-2022 at the college farm of Kulbhaskar Ashram Post Graduate College, Prayagraj District, Uttar Pradesh. The experiment was laid out with 11 treatments in Randomized Block Design with 3 replications. Of all the treatments, T11 (100% RDF through inorganic fertilizers (80:40:50 kg NPK ha-1)) has shown the significant improvements in growth parameters than other treatments. The treatment (T11) recorded the highest plant height (28.46cm), No. of leaves (17.15), and leaf area (426.12). On 45 DAS over the combination treatment and the lowest growth characters recorded by T10 (100% RDN through organic fertilizers + Bio-fertilizers.

Keyword : *Palak , integrated nutrient management, growth*

INTRODUCTION

Among different vegetable crops, leafy vegetables are quite high in their protective food value. They are important because of their successful and relatively easy cultivation as well as their high nutritive value, at a comparatively low cost. Palak or spinach beet (*Beta vulgaris. Var. bengalensis*) is one of the most popular leafy vegetables grown widely in India. Its tender soft succulent leaves are used as vegetable. Being the cheapest source of calcium, iron and phosphorus, it is valued much for its tender leaves. The continuous Use of chemical fertilizers and pesticides in the cultivation of horticulture crops have caused decreased soil fertility physical and chemical properties of soil. Organics play a vital role in restoring thesoil fertility and stabilizing crop productivity. Therefore, the application of plant nutrients through organic sources like FYM, vermicompost, biofertilizer along with different

foliar spray remains the alternate choice for maintaining sustainable production. With an intention to increase the yield of greens, farmers are tempted to apply higher quantities of nitrogenous fertilizers, which may lead to accumulation of anti-nutrient factors in the greens beyond permissible limit. Hence, there is a need to substitute the inorganic nutrient requirements with organic nutrient sources to enhance the production of greens with lower content of anti-nutritional factors. With this background, the present study was undertaken in order to study the effect of organic manuring practices to improve the growth and yield of palak (*Beta vulgaris* var. *bengalensis* Hort.).

MATERIALS AND METHODS

The Experiment was conducted during rabi season 2021-22 at the college farm of Kulbhaskar Ashram Post Graduate College, Prayagraj, Uttar Pradesh. The experiment is laid out with Randomized Block Design with 3 replications and 11 treatments. The 11 treatments combinations were, T1 -70% RDF through inorganic fertilizers+ 30% RD of nitrogen through VC T2 -70% RDF through inorganic fertilizers + 30% RD of nitrogen through FYM T3- 70% RDF through inorganic fertilizers + 30% RD of nitrogen through PM T4- 55% RDF through inorganic fertilizers + 45% RD of nitrogen through VC T5 - 55% RDF through inorganic fertilizers + 45% RD of nitrogen through FYM T6 - 55% RDF through inorganic fertilizers + 45% RD of nitrogen through PM T7 - 30% RDF through inorganic fertilizers +70% RD of nitrogen through VC T8 - 30% RDF through inorganic fertilizers + 70% RD of nitrogen through FYM T9 - 30% RDF through inorganic fertilizers + 70% RD of nitrogen through PM T10 -100% RD nutrients through organic manures (33.3% VC + 33.3% FYM + 33.3% PM). T11 - 100% RDF through inorganic (80:40:50 kg of NPK ha-1).

The variety All Green was used as the test crop. As per the treatment vermicompost, farmyard manure and poultry manure along with Bio-fertilizers were applied as soil basal application.

All the treatments are applied with Bio-fertilizers, viz, *Azospirillum* @5kg ha -1 +PSB@ 2kg ha -1.. Inorganic Fertilizers is applied as per treatment, Nitrogen is applied as a basal dose in 4 equal split 1/4 th of total nitrogen is applied at last ploughing and remaining 3 split after each cutting in the form of Urea. Phosphorus and potassium is applied as a basal dose at last ploughing in the form of single super phosphate and muriate of potash.

RESULTS AND DISCUSSION

Plant height

Application of (100%RDF through inorganic fertilizers (80:40:50 kg of NPK ha-1) T11 resulted in significantly higher plant height (16.63cm) followed by T3 (16.01). The minimum plant height was recorded in T10 (9.42) which was on par with T8 (11.53cm) and T7(11.96cm) at 30 days of sowing. At 45 DAS the treatment T11 (100% RDF through inorganic fertilizers 80:40:50 kg NPK ha-1) resulted highest plant height (28.46cm) followed by T3(27.06cm). The minimum plant height was recorded in T10 (16.58cm) and which is on par with T8 (18.63cm) (Table. 1). Inorganic fertilizers release readily available form of nitrogen at higher quantities. This might have resulted in increase in vegetative growth of plants mainly by elongation of cells and partly by cell division. Nitrogen is a important constituent of protoplasm and its favorable effect on chlorophyll content of leaves might have increase the synthesis of carbohydrates, amino acids etc. from which the phytohormone such as auxins, gibberellins, cytokinins and ethylene have been synthesized resulting in increase plant height. Similar result were also reported by (Maynard and David, 1987).

Number of leaves

The data on numbers of leaves varied at different

intervals are presented in (Table. 1) At 30 DAS T11(100%RDF through inorganic fertilizer (80:40:50 kg NPK ha-1)recorded maximum no. of leaves (14.12) which was on par with T3 (13.92) and T1 (13.42). Minimum no. of leaves were reported in T10 (7.16) followed by T8 (8.39) and T7 (9.18). At 45 DAS T11 (100%RDF through inorganic fertilizer (80:40:50 kg NPK ha-1) has highest no. of leaves(17.15) which was on par with T3 (16.72) and T1 (15.82).Minimum no. of leaves were reported in T10 (8.43) followed by T8 (9.82) and T7 (10.18). Inorganic fertilizers release nutrient at fast rate and in higher quantity and application of bio- fertilizers . which improves secreation of growth promoting substance, might have led to improvement in nutrient uptake which directly influenced no. of leaves. These result are in confirmation with the findings of Koppad *at el* (2019) in red cabbage and Khadse *at el* (2021) in spinach. .

Leaf Area

The data on leaf area varied at different Interval are presented in (TABLE 1)At 30 days after sowing the highest leaf area was recorded in treatment T11. (100%RDF through inorganic fertilizers (80:40: 50NPK kg /ha)) (378.92cm2) which was on par with T3 (359.62 cm2) and T1(336.96cm2).The lowest leaf area was recorded in T10 (276.82cm2) followed by T8 (296.18cm2). At 45 DAS the highest leaf area plant – 1 (426.12cm2) at harvest was recorded with T11 100%RDF at inorganic fertilizers which was on par with, T3 –70% RDF through inorganic fertilizers +30%RDN through PM along with biofertilizers (398.23) and T1-70%RDF through inorganic fertilizers +30% RDN through VC along with biofertilizers (382.23cm2). This could be attributed to the production of greater number of photosynthetically active leaves because of adequate nitrogen which might have lead to higher metabolic activity resulting in higher production of carbohydrates and phytohormones. These might have enhanced the growth and leaf area in plants. Similar results were also recorded by **Madhavi *et al.*** (2008) with higher levels of poultry manure along with biofertilizers in spinach.

Table - 1 : Effect of Integrated Nutrient Management Practices on Plant Height (cm), No. of Leaves Per Plant, Leaf Area (cm²)

	Plant height in (cm)			No. of leaves per plant			Leaf area per plant (cm^2)		
	15 DAS	30 DAS	45DAS	15 DAS	30 DAS	45DAS	15 DAS	30DAS	45DAS
T_1	10.58	15.34	26.32	4.29	13.42	15.82	118.62	336.96	382.23
T_2	10.16	14.72	25.26	4.15	12.98	14.96	112.79	322.35	376.12
T_3	11.05	16.01	27.06	4.48	13.92	16.72	124.84	359.62	398.23
T_4	8.26	13.72	22.72	3.76	10.64	13.17	102.28	314.68	366.73
T_5	7.98	13.43	21.63	3.55	10.53	12.49	98.73	312.37	362.82
T_6	8.93	13.98	23.82	3.82	10.92	13.63	110.43	318.57	368.82
T_7	7.54	11.96	19.16	3.15	9.18	10.18	88.86	302.32	352.21
T_8	7.43	11.53	18.63	3.08	8.39	9.82	82.22	296.18	346.89
T_9	7.78	12.32	20.78	3.18	9.68	10.96	91.14	304.41	358.39
T_{10}	5.35	9.42	16.58	2.53	7.16	8.43	84.59	276.82	326.64
T_{11}	11.49	16.63	28.46	5.52	14. 12	17. 15	138.76	378.92	426. 12
Mean	8.81	13.55	22.81	3.77	11.09	13.03	104.84	320.29	369.56
SEm+ -	0.43	0.50	0.72	0.09	0.31	0.45	2.11	2.92	2.69
C. D at5%	1.31	1.52	2.14	0.27	0.96	1.37	6.31	8.70	8.03

CONCLUSION

Based on the result it was concluded that the Treatment T11 (100%RDF through inorganic Fertilizers 80: 40:50 kg ha-1) has highest plant height, No. of leaves and leaf area but it is unsustainable because continuous use of inorganic Fertilizers without organic manure cause nutritional imbalance in soil and reduce microbial activity, so the best treatment is T3 (70%RDF through inorganic Fertilizers +30%RDN through PM) was found better plant height, No. of leaves, leaf area. It is recommended for economic and Sustainable Production of palak.

REFERENCES

1. Khadse VA, Mohod AA, Chirde PN and Chauhan AK, 2021, Response of leafy vegetables under organic and integrated nutrient management. *The Pharma Innovation Journal, 10(5),04-06.*
2. Koppad S, Mantur SM, Biradar Ms and Shripad K, 2019, Effect of Integrated nutrient management in red cabbage grown under shade House condition. International Journal of current Microbiology and Applied science, 8(9):1294-130131.
3. Jaya Sharma and A. Sunita. 2014. Impact of organic fertilizers on growth, yield and quality of spinach. Indian J. Plnt Sci, 3 (3)
4. Manoj Kumar, D. Bikash, K. K Prasad and Prashant Kumar. 2013. Effect of integrated nutrient management on growth and yield of broccoli (*Brassica oleracea* var. *italica*) under Jharkhand conditions. Veg. Sci., 4: 11
5. Madhavi Y, Goud P V, Reddy K M and Saidulu A 2008 Effect of different levels of vermicompost, castor cake, poultry manure and biofertilizers on dry matter production, nutrient uptake and economics of Indian spinach Orissa Journal of Horticulture. 2008. 36: 1, 53-58. 6.
6. Balasubramani P 1988 Studies on the effect of *Azospirillum* and nitrogen on growth and yield of bhendi var. Pusa swani M. Sc (Ag). Thesis, Tamil Nadu Agricultural University, Coimbatore.
7. Kalyani D P, Sankar CR and Prasad D M 1996 Studies on the effect of nitrogen and *Azospirillum* on growth and yield of cauliflower. South Indian Horticulture 44: (56): 147-149.
8. Jha M K and Jana J C 2009 Evaluation of vermicompost and farm yard manure in integrated nutrient management of spinach (*Beta vulgaris var.bengalensis).* Indian Journal of Agriculture Science 79(7):538-541.12.
9. Mallangouda B, Salikeri GS, Hulamani N C, Murthy B and Madalgeri B B 1995 Effect of NPK and 6
10. FYM on growth parameters of onion, garlic and coriander current research OAS Bangalore 24(11):212-213.
11. Choudhari M R, Talukdar N C and Saikia A 2005 Effect of Integrated nutrient management on growth and productivity of brinjal. Research on crop6(3):551554.

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EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON GROWTH, YIELD AND QUALITY OF GUAVA VARIETIES IN THE PRAYAGRAJ DISTRICT OF UTTAR PRADESH

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ABSTRACT

"Effect of Integrated Nutrient management on Growth, Yield and Quality of Guava (PsidiumGuajava L.) Varieties". "Myrtaceae" family. During 2021-2022 rainy season crop at the Horticulture Farm of Chandra Shekhar Azad Park Prayagraj Uttar Pradesh Under Kulbhaskar Ashram Post Graduate College Prayagraj UP. The Experiment was laid out with 6 treatments in factorial randomized block design with 3 replications of all the treatments. Varieties are Surkha, Chittidar, L-49 and Allahabad Safeda. T6 (100% RDF through Organic Fertilizers (FYM and Vermicompost), Inorganic Fertilizers & Bio-Fertilizers (295:144:150 g NPK/Plant)) has shown the significant improvements in growth parameters and yield parameters than other treatment. The Surkha Variety recorded the highest plant height (242.05 cm) Trunk Girth (7.00cm) and Yield per Hectare (225.01 q). The L-49 Variety recorded the highest fruit weight (115.05g). On Fifteen years old Guava trees over the combinations treatments and the lowest growth characters recorded by Variety is Allahabad Safeda.

Keywords : *Guava, growth, yield*

INTRODUCTION

Guava (Psidium Guajava L.) is one of the important commercial fruits in India. This comes under "Myrtaceae" family. Guava is grown in both sub- tropical and tropical regions up to 1500. It tolerates high temperatures and drought conditions prevalent in north India in summers. It is the fourth most important fruit after mango, banana and citrus. The continuous use of chemical fertilizers and pesticides in the cultivation of horticulture crops have caused decreased soil fertility physical and chemical properties of soil. Organics play a vital role in restoring the soil fertility and stabilizing crop productivity. Therefore, the application of plant nutrients through organic sources like FYM, vermicompost and biofertilizer maintaining sustainable production. With an intention to increase the yield of guava fruit. Guava are harvested throughout the year (except during May and June). However, peak harvesting periods inNorth India are

August for rainy season crop, Nov.-Dec. for winter season crop and March-April for spring season crop. Guava is considered as a tropical apple because of good source of nutritional value per 100g, like energy 285kJ, protein 2.55g, Niacin(B_3) 1.084mg, Vitamin C 228.3mg Thiamine(B_1) 0.03-0.07mg, Calcium 18mg, Iron 0.26mg, Potassium 417mg, Phosphorous 40mg, Magnesium 22mg and Lycopene 5204 µg etc. It is also good source of pectin. Hence, there is a need to substitute the organic nutrient requirements with inorganic nutrient sources to enhance the production of lower content of anti-nutritional factors. With this background, the present study was undertaken in order to study the effect of integrated nutrient management to improve the growth and yield of guava (Psidium Guajava L.).

MATERIALS AND METHODS

The experiment was conducted on "Effect of Integrated Nutrient Management on Growth, Yield and Quality of Guava Varieties (Psidiumguajava L.)during rainy season crop year 2021-2022 at Horticultural farm of Chandra Shekhar Azad Park Prayagraj Uttar Pradesh under Kulbhaskar Ashram PG College Prayagraj. The experiment was laid out with 6 treatments in factorial randomized block design with 3 replications of all the treatments and their combination. We get 4 varieties of guava (Surkha, Chittidar, L-49 and Allahabad Safeda) and there is a same treatment and composition in all varieties are T_1(Control), T_2(100%RDF), T_3(75%RDF+FYM+ 2.0kg Vermicompost+50gm Trichoderma), T_4(75%RDF+FYM+2.0kg Vermicompost+50gm Azotobacter), T_5(75%RDF+FYM+2.0kg Vermicompost+50gm Azospirillum) and T_6(75%RDF+FYM+2.0kg Vermicompost+50gm PSB).Varieties are V_1 is Surkha,V_2 is Chittidar, V_3 is L-49 and V_4 is Allahabad Safeda.All Varieties of guava used as a test crop.The entire dose of nutrient was applied from organic sources, i.e., FYM, Vermicompost and Bio-Fertilizer were applied as a basal dose before the start of the monsoon. Bio-Fertilizers such as Trichoderma, Azotobacter, Azospirillum and PSB were used. In-Organic Fertilizer were used Urea, DAP, MOP. After applying the treatments,it was mixed in the soil around the tree. Irrigation was applied drop wise with a discharge rate of 4lit/hour/emitter immediately after the application of manures and fertilizers.

RESULTS AND DISCUSSION

Plant Height

Application of T_4 (75%RDF+10kg FYM+2.0kg Vermicompost+50gm Azotobacter) among all varieties V_1Surkha show significantly maximum plant height in table 1 which was (242.5 cm) followed by V_2Chittidar with plant height of (235.9 cm). Minimum plant height (228.7 cm) was recorded in V_4 Allahabad Safeda. This result where found similar with Paikra et.al. (2015).

The maximum plant height of guava variety Surkha might be due to varietal-characterofgenetic-makeuporalsomightbedueto"better-adaptability" inclimatic-condition this finding was found similar with Singh et al. (2016).

The release of plant growth hormones (IAA) resultant in enhancement of plant height and increasein nutrient availability in the rhizosphere and rhizoplane. The biofertilizers (Azotobacter sp.) used in the experiment hadpositive effect for IAA production. The increased plant height might be due to balanced inorganic fertilizer and organic fertilizer along with azotobacter significantly uplift the nitrogen-availability because of capacity to fix largeamount of atmospheric nitrogen which ultimately led to production of more photosynthates resulted into high increase in plant height, similar finding was obtained by Sharma et al. (2018).

Trunk Girth(cm)

Application of T_4 (75%RDF+10kg FYM+ 2.0kg Vermicompost+50gm Azotobacter) among all varieties V_1Surkha show significantly maximum trunk girth in table 2 which was (7.00cm) followed by V_2Chittidar with trunk girth of (6.91cm). Minimum trunk girth (6.50cm) was recorded for V_4 Allahabad Safeda. This result where found similar with Gurjaret al. (2015).

Same as the treatment of the plant height for the trunk girth are same.

Fruit Weight

Application of T_4 (75%RDF+10kg FYM+2.0kg Vermicompost+50gm Azotobacter) among all varieties V_3 L-49 show significantly maximum fruit weight(g) in table 3 which was (115.05g) followed by V_4 AllahabadSafeda with fruit weight of (114.70g). Minimum fruit weight (108.25g) was recorded for V_2Chittidar. This result where found similar with Mehta et al. (2018).

Enhancement of various physiological phenomenon from source to sink viz.rateoftrans location of photosynthates, photosynthetic efficiency was may be due to genotypic in association which resulted in increase in volume of fruit. This finding was supported by Singh et al. (2013).

The reason behind it might be due to fact that higher dose of NPK (2/3rdof recommended dose) along with vermicompost/FYM and biofertilizers have better impact on inducing more number off lowers per shoot. The enhancement of fruit growth (g) was due to prolonged availability of nutrients during the grow the period from vermicompost the finding was similar as that of Meenaet al. 13).

Fruit yield per Hectare(q)

Application of T_4 (75%RDF+10kg FYM+2.0kg Vermicompost+50gm Azotobacter) among all varieties V_1Surkha show significantly maximum yield per hectare in table 4 which was (225.05q) followed by V_3 L-49 with yield per hectare of (143.02q). Minimum yield per hectare (112.05q) was recorded for V_4 Allahabad Safeda. This result where found similar with Paikraet al. (2015).

Table - 1 : Effect of Different INM and Guavava Rietieson Plant Height (cm).

Treatment		Plantheight(cm)
FactorA. Varieties(4Varieties)		
V_1	Surkha	242.5
V_2	Chittidar	235.9
V_3	L-49	230.5
V_4	AllahabadSafeda	228.7
S.Em.		0.69
C.Dat 5%		1.99

Table - 2: Influence of Different INM and Guavava Rietieson Trunk Girth (cm).

Treatment		Trunk girth(cm)
FactorA.Varieties (4Varieties)		
V_1	Surkha	7.00
V_2	Chittidar	6.91
V_3	L-49	6.61
V_4	AllahabadSafeda	6.50
S.Em.		0.003
C.Dat 5%		0.008

Table - 3 : Influence of Different INM and Guavava Rieties on Fruit Weight(g)

Treatment		Fruitweight(g)
FactorA.Varieties(4Varieties)		
V_1	Surkha	113.30
V_2	Chittidar	108.25
V_3	L-49	115.05
V_4	AllahabadSafeda	114.70
S.Em.		1.262
C.Dat 5%		3.603

Table - 4 : Influence of Different INM and Guavava Rieties on Fruit Yield Per Hectare (q).

Treatment		Fruit yield perhectare (q)
FactorA.Varieties(4Varieties)		
V_1	**Surkha**	**225.01**
V_2	Chittidar	118.08
V_3	L-49	143.02
V_4	AllahabadSafeda	112.05
S.Em.		2.602
C.Dat 5%		7.432

CONCLUSION

Based on the results the following conclusion are drawn from the investigation. It can be concluded that by decreasing the RDF for 25% and adding organic manure like vermicompost, FYM &biofertilizer can enhance the growth, yield and quality of the guava.

For ultra-high-density production of guava variety Surkha can be concluded superior for growth and yield. It can be concluded that INM and guava variety in combination of (Surkha+75%RDF+10kg FYM+ 2.0kg Vermicompost+ 50gm Azotobacter) was most superior treatment combination for growth and yield. (Surkha+75%RDF+10kg FYM+ 2.0kg Vermicompost+ 50gm Azospirillum) and (Surkha + 75%RDF + 10kg FYM + 2.0kg Vermicompost+ 50gm PSB).

Biofertilizer like Azotobacter, Azospirillum and PSB has a lot of beneficial effect in all the parameter like growth and yield.

REFERENCES

1. Athani,S.I.,Prabhuraj, H.S.,Ustad, A.I., Swamy, G.S.K., Patil, P.B.and Kotikal, Y.K. 2007 a. Effect of organic and inorganic fertilizers ongrowth, leaf, major nutrient and chlorophyll content and yield ofguava cv. Sardar. Acta Hort., 735: 351-356.
2. Baviskar, M.N., Bharad, S.G., Dod, V.N. and Varsha, G. 2011. Effect ofintegrated nutrient management on yield and quality of sapota. Plant Archives, 11(2): 20-26.
3. Chandra, V.,Sharma, H.G. and Dikshit,

S.N.2016. Effect of chemical fertilizers, organics manure and biofertilizers on growth, yield and quality of mrigbahar guava (Psidiumguajava L.) Current Advances in Agricultural Sciences, 8(1): 114-116.

4. Dutta, P.,Maji, S.B. and Das, B.C.2009. Studies on there sponse of biofertilizers on growth and productivity of guava. Indian Journal of Horticulture, 66(l): 39-42.

5. Ghosh, S.N. 1991. Nutritional requirement of guava (Psidiumguajava L.) in laterite tract of West-Bengal. Indian Agriculture, 35(4): 231-238.

6. Gupta, P., Singh, D., Prasad, V.M. and Kumar, V. 2019. Integrated nutrient management on yield and quality of guava (Psidiumguajava L.) cv. Allahabad Safeda under high density planting. The pharma innovation, 8(1): 320-323.

7. Lodaya, B.P. and Masu,M.M.2019.Effect of biofertilizer, manures and chemical fertilizers on fruit quality and shelf life of guava (Psidiumguajava L.) cv. Allahabad Safeda. International Journal of Chemical Sciences, 7(4): 1209-1211.

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NEPHROTOXIC EFFECTS OF CERTAIN MICRONUTRIENTS IN HYPERGLYCEMIC ALBINO RATS

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ABSTRACT

Necessary metal called chromium appears to be helpful in controlling insulin activity, metabolic syndrome, and cardiovascular disease. Without chromium, the insulin hormone would not operate properly in human bodies. Rats in the healthy control group had kidney tissues that displayed normal cortical and medullary region architecture. Glomeruli material filled Bowman's capsule. A photomicrograph of the kidney of a diabetic rat treated with zinc, chromium, and selenium revealed modest glomerulus degradation.

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Keywords : *Micronutrients, diabetes, hephrotoxic effect*

INTRODUCTION

It is generally known that zinc ions play a key role in the control of many cellular functions, making it a necessary dietary supplement for humans. Zinc's insulin-like activities and probable connection to insulin resistance and type 2 diabetes are among its noteworthy in vivo properties.

Furthermore, the zinc ion is the basic supporter in the insulin microcrystal structure, and prolongs the collapse of insulin crystals from polymers (usually hexamers) to monomers which can be absorbed in body. Zinc is known to enhance the stability of insulin crystal structure through the formation of zinc-containing hexamers.

The activity of insulin, as well as the metabolism of carbohydrates, depend heavily on zinc. Hyperglycemia is the primary characteristic of type 2 diabetes mellitus, which is brought on by decreased insulin production and increased insulin resistance. Numerous studies have demonstrated that diabetes alters zinc metabolism. The often observed insufficient effectiveness of oral hypoglycemic drugs may be ascribed to insufficient post receptor events linked to oxidative damage brought on by prolonged hyperglycemia.

Selenium is a universal essential trace element for mammals which is important for many cellular processes. A new biological perspective of

se was shown by the pioneering work of Schwarz and flats (1957) who reported that selenium at very low dietary concentrations is an essential nutrient.

Selenium is generally efficiently absorbed through diet, and if it is in an organic form, it works even better since selenoproteins, which contain selecnocysteins, operate as antioxidants. The best-known glutathione peroxidases, thio-redoxi-reductases, and iodo-thyronine-deiodonases are among the approximately ten distinct selenoproteins that are described. Additionally, selenoproteins are in charge of delivering such to tissues. While severe selenium shortage is uncommon, diabetics have lower amounts of selenium as well as higher levels of oxidative stress.

Deficiency of chromium can result in hypoglycemia or presentation of diabetes. Even in a healthy person, supplemental chromium can increase insulin sensitivity, and decrease fasting serum glucose and indigenous insulin production. Treatment of type 2 diabetes with chromium has led to improvement in serum glucose, insulin and hemoglobin levels. Organic chromium complexes give better results than inorganic chromium better results than inorganic chromium glucose control also improves in type 1 diabetes. Chromium is effective in reversing the diabetes caused by therapeutic use of glucocorticoids. The effects on chromium on blood glucose homeostasis are accomplished by increased activation of insulin receptors.

In view of the potent antioxidant and anti-inflammatory effects of so and the prominent role played by these disorders in insulin resistance and diabetes, supplementation with se in such diseases appears worthwhile.

Historical Review

Hypoglycemic effect of Zinc:

Zn is a remarkable antioxidant, it acts as specific sites where it can complete for iron and copper, it further binds to SH groups in proteins, protecting than from oxidation (Bettger,1993). Garg*et al*. (1994) experimented and found serum zinc levels in diabetics to be significantly reduced as compared to healthy controls.

Several of the complications of diabetes may be related to increased intracellular oxidants and free radicals associated with decrease intracellular zinc and in Zn dependent antioxidant enzymes. There appears to be a complex interrelationship between Zn and both type 1 and type 2 diabetes (Chausmer, 1998).

Anderson *et al*. (2001) performed experiments to determine the effects of combined zinc and chromium supplementation on oxidative stress and glucose homeostasis of people with type 2 diabetes.

Dunn Michael (2005) stated that zinc and calcium ions play important roles in the biosynthesis and storage of insulin. Experimental manipulations of Zn status in rodent models of diabetes provide a valuable approach to explore mechanisms for the protective effects of Zn (Taylor and Carla, 2005).

Hypoglycemic effect of selenium:

A cross sectional study in almost 9000 American adults as well as another analysis reported a positive link between high selenium levels and diabetes. (Bleys J. et al. 2007 and Laclaustra M. et al. 2009). Kornhauser C. et al. 2008 demonstrated selenium protection against diabetes. One study showed that non-diabetic individuals had higher serum selenium concentration compared to the diabetic individuals.

Experimental data suggest that supplementation with antioxidants such as Selenium at the nutritional level, could delay the development of type 2 diabetes by decreasing oxidative stress. (Steinbrenner H. 2009).

O. Akinloye et al. (2010) investigated the level of selenium (Se)(an antioxidant element) in

serum of patients with type 2 diabetes mellitus. The serum concentration of selenium was significantly lower in diabetic patients when compared with the control group.

Hypoglycemic effect of chromium:

Chromium decreases insulin resistance in rats fed a high fat, low cr diet (Containing 33 ug Cr/kg) (Stiffler et al. 1998).

Anderson *et al*. (2001) performed a study to determine the effects of combined Zinc (Zn) and Chromium supplementation on oxidative stress and glucose homeostasis of people with type 2diabetes. It also decreased oxidative stress, glycosylation and lipid peroxidation in erythrocytes and monocytes under hyperglycemic condition. (Jain S.K. 2001)

The same holds true for an association of some trace elements such as Chromium or Zinc with oral antidiabetics. (Nicolas wierensperger and Jean Robert Rapin 2010).

MATERIALS AND METHODS

Experimental animal:

The male albino rat, *Rattus norvegicus* has been selected for the present study. The albino rats were obtained from Zamia Hamdard University and AIIMS, New Delhi (India).

Maintenance and feeding of experimental animal:

Healthy albino rats of almost equal size and weight ranging from 150-200 gm ±10gm were kept in polypropylene cages measuring 45×27×15 cm at the temperature 25 ± 0.5°C, and photoperiod 08hrs per day. The rats were acclimated for three weeks prior to the experiment. The top of cages was made of galvanized steel mesh. The rats were fed on standard rat and mice feed and water was provided *adlibitum*.

Induction of Diabetes:

Diabetes mellitus was induced by intraperitoneally injecting alloxan monohydrate, dissolved in normal saline (12.5mg/100g). After an interval of 15 days, Diabetes mellitus was confirmed by blood sugar analysis applying Folin-Wu method, using a commercial kit. Present investigation was conducted on 150 to 200 $\pm$ 10 gm weight albino rats.

Experimental Design

Present investigation was conducted on alloxan induced diabetic albino rats *Rattus norvegicus*) to find the hypoglycemic effects of micronutrients (Zinc, Selenium and chromium). In this study we procured 150 to 200 $\pm$ 10 gm weight albino rats from breeding centers. The experimental albino rats were categorized into five main groups viz. A, B, C, D and E of healthy, diabetic and treated rats along with micronutrients namely.

Group-A This group was kept five healthy control albino rats without any micronutrient mixed food for 30 days duration of experiment.

Group-B This group was kept five (without any treatment) alloxan induced diabetic control rats for 30 days duration of experiment.

Group-C This group was kept five diabetic rats and feed upon zinc mixed food (@ 5.0mg/kg body wt.) for 30 days.

Group-D This group was kept five diabetic rats and feed upon selenium mixed food (@ 5.0g/kg body wt.) for 30 days.

Group-E This group was kept five diabetic rats and feed upon chromium mixed food (@ 5.0mg/kg body wt.) for 30 days.

Experimental investigations were made on hypoglycemic effect of micronutrients (Zinc, Chromium and Selenium) in albino rats on the basis of following studies:

Histopathological Studies:

Following tissue was taken for histopathological study:

a. Kidney

RESULTS AND DISCUSSION

These findings may provide a clue to evaluate the use of oral administration of micronutrients in diabetic persons. In the present study following observations of hematological, biochemical and histopathological parameters were as follows:

HISTOPATHOLOGICAL STUDIES:

a. Kidney:

Healthy control group [Fig.- 1]

Kidney tissue of control rats showing normal architecture of cortical and medullary region. Bowman's capsules filled with glomeruli material. Kidneys are the site of filtration of blood to remove waste metabolic product that are detoxified by the liver or are being produced in other cells of the body. The outer region which harbours numerous glomeruli is referred as cortex whereas inner region possessing renal tubules mainly named as medulla. The glomeruli appear as a tuft of fine blood capillaries present in the depression of Bowman's capsules. Inner wall of capsule together with endothelium of glomerular capillaries constitutes filtration bed of kidneys.

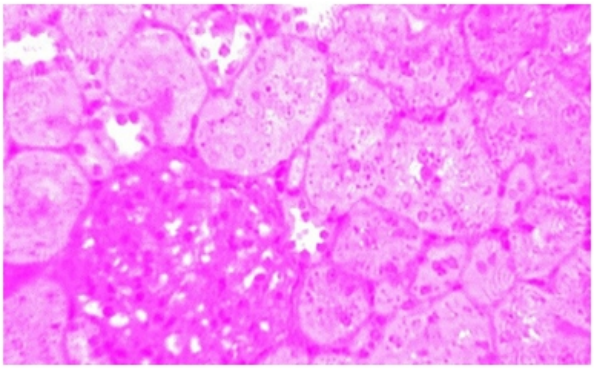

Fig. - 1 : T.S. of Kidney of healthy control rat(400X)

Diabetic control group [Fig.- 2]

Photomicrograph of kidney tissue was showing the ruptured endothelial lining of glomerulus. After induction of alloxan treatment mild tubular exfoliation was noticed in the uriniferous tubules.

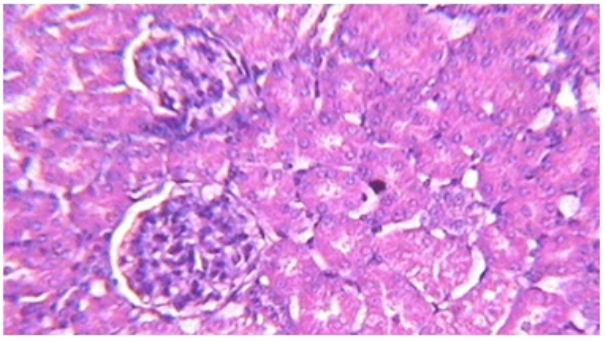

Fig. - 2 : T.S. of Kidney of Diabetic control rat(400X)

Experimental group treated with zinc, selenium, chromium [Fig.- 3,4]

After post treatment with zinc, selenium and chromium, it was showed that mild damage in the Bowman's capsule was observed. After post treatment of alloxan induced albino rats, it was observed that cortical and medullary region tend to recoup to their normal histoarchitecture and almost the normal glomerulus was observed.

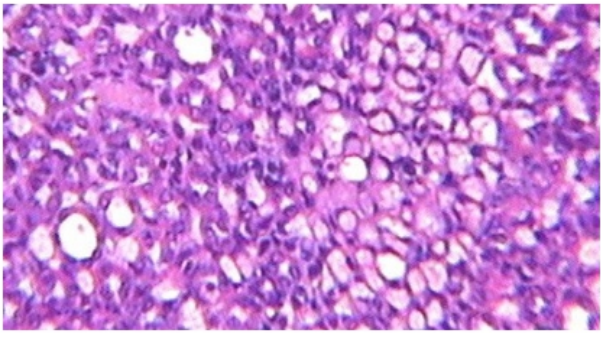

Fig. - 3 : T.S. of Kidney of Diabetic rat treated with Zinc (400X)

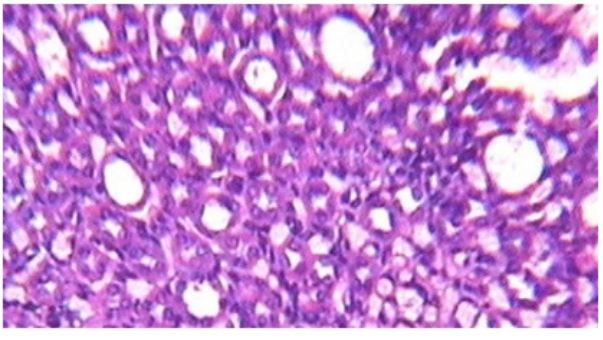

Fig. - 4 : T.S. of Kidney of Diabetic rat treated with Selenium (400X)

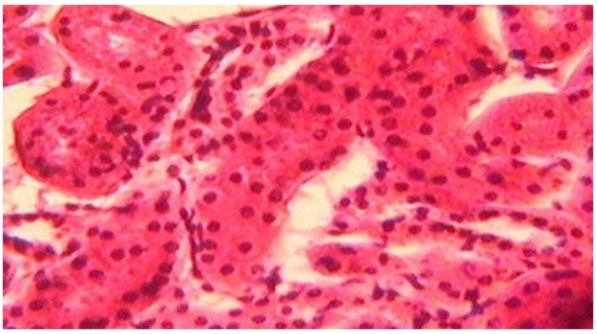

Fig. 5- T.S. of Kidney of Diabetic rat treated with Chromium (400X)

REFERENCES

1. Anderson R.A. :Chromium in the prevention and control of diabetes. *Diabetes metab*. 2000 Feb; 26(1):22-7.
2. Anderson R.A. :Potential antioxidant effects of Zinc and Chromium supplementation in people with type 2 diabetes mellitus. *Journal of the American college of Nutrition* .20 (3) : 212-218, 2001.
3. Anderson R.A., Cheng N., Bryden N.A., Polansky M.M., Chi J., and Feng J. :Elevated intakes of supplemental chromium improve glucose and insulin variables in individuals with type 2 diabetes. Diabetes 46:1786-1791, 1997.
4. Akinloye, O., Ogunleye, K., & Oguntibeju, O. O. (2010). Cadmium, lead, arsenic and selenium levels in patients with type 2 diabetes mellitus. *African journal of biotechnology*, *9*(32), 5189-5195.
5. Bleys, J., Navas-Acien, A., & Guallar, E. (2007). Serum selenium and diabetes in US adults. *Diabetes care*, *30*(4), 829-834.
6. Bleys J., Acien A.N., and Guallar E. :Serum selenium and diabetes in U.S. adults. *Indian Journal of Experimental Biology*. Vol. 47 (07), 2009.
7. Diabetes Pandemic: International Diabetes Federation. The IDF
8. *Diabetes Atlas. 5th Edition, 2012 Update. Brussels: International Diabetes Federation;* 2012.
9. Garg V.K., Gupta R, and Goyal R.k. :Hypozincemia in diabetes mellitus. *J. Assoc Physicians India* 1994 Sep; 42(9) : 720-1.
10. Golik A., Cohen N, Ramot 7, Maor J., Moses R., and Weissgarten J., Type II diabetes mellitus congestive heart failure, and zinc metabolism. *Biol Trace Elem Res* 1993.
11. Gunasekara P, Hettiarachchi M., Liyanage C., and Lekamwasam S.: Blood sugar lowering effect of Zinc and multivitamin /mineral supplementation is dependent on initial fasting blood glucose. *Journal of Diabetology*, Feb 2011; 1:2
12. Hiromura M., and Sakurai H. (2008): Action mechanism of metallo-allixin complexes as antidiabetic agents. *Pure Appl. chem*., Vol 80, No. 12, pp 2727-2733,
13. Jain, S. K., & Kannan, K. (2001). Chromium chloride inhibits oxidative stress and TNF-α secretion caused by exposure to high glucose in cultured U937 monocytes. *Biochemical and biophysical research communications*, *289*(3), 687-691.
14. Jansen J., karges W., and Rink L. (2009): Zinc and diabetes-clinical links and molecular mechanism, *J Nutr Biochem*, 20:399-417.
15. Jeyabalan S., and Palayan M. (2009): Antihyperglycemic and antidiabetic activity of leaves extracts of Sapindusemargina-tusvahl. *Asian biomed*. 3 : 313-18.
16. Kimura K. (1996): Role of essential trace elements in the disturbance of carbohydrate metabolism. *Nippon Rinsho*; 54:79-84.
17. Kinlaw W.B., Levis A.S., Morley J.E., Silvis S.E., and McClain CJ. (1983): Abnormal zinc metabolism in type II diabetes mellitus. *Am J med*:75, 273-277.
18. Kleefstra N., Houweling S.T., Baker,

Verhoeven S., Gans R.O.B., Jong B. M-DE, and Bilo H.J.G (2007): Chromium treatment has no effect in patients with type-2 diabetes in a western population. *Diabetes care*30 : 1092-1096.

19. Krentz A.J., Ferner R.E., and Bailey C.J. (1994): Comparative tolerability profiles of oral antidiabetic agents. *Drug Saf.* Oct, 11 (4) : 223-41.
20. Li F., Wu Y., Zou Y., Zhao T., Xhang M., Feng W., and Yang L. (2012): Food Chem.*Toxical*50(5), 1623-1631*Epub*Feb-18.
21. Louise A., Berben and Jeffery R., Lang (2005) : *Inorg Chem. J.* 44, 8459-8468.
22. Shen XiQ, Huang K.X., and Xu H.B.(2004): New experimental observation on the relationship of selenium and diabetes mellitus. *Biological Trace Element Research*. Summer, Vol 99, issue-1-3, pp 241-149.
23. Steinbrenner, H., & Sies, H. (2009). Protection against reactive oxygen species by selenoproteins. *Biochimica et Biophysica Acta (BBA)-General Subjects*, *1790*(11), 1478-1485.
24. Wiernsperger N., and Rapin J.R. (2010): Trace elements in gluco metablic disorders : an update. *Diabetology and metabolic syndrome* ,2:70.

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STUDY THE EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON GROWTH, YIELD AND NUTRIENTS UPTAKE OF GARLIC (ALLIUM SATIVUM L.) CV. G-323

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ABSTRACT

The present field experiment entiteled " was carried out during rabi season of the year 2021-2022 at Kulbhaskar Ashram Post Graduate College, Prayagraj U.P. The experiment " Study the Effect of Integrated Nutrient Management on Growth, Yield and Nutrients Uptake of Garlic (Allium sativum L), cv.G-323 "experiment was laid out in a randomized block design (RBD) with three replicated 12 treatments viz., in all treatment T9 (100% Inorganic fertilizers+ Azospirillum) shown higher growth parameters then other treatments, the treatment recorded higher plant height at 120 DAP (69.32cm), number of leaves per plant at 120 DAP (7.96cm), Neck thickness at 120 DAP (1.25) T9 , the lowest growth parameters then other treatments, the treatment T1(control) recorded lowest plant heigh at (50.96) number of leaves /plant (5.48) , Neck thickness (0.31cm)

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Keywords : *Integrated nutrient management, growth, garlic*

INTRODUCTION

Garlic is grown as an annual crop. The edible part, which is compose of several bulb lets or segments called "clove". The therapeutic value of garlic has attracted the attention of one and all since Vedic era and every Indian home can prescribed garlic based effective treatment for many common ailments, because of its medicinal properties .It is rich in protein, phosphorus, potash, calcium, magnesium and carbohydrates. Ascorbic acid content is very high in green garlic (Pandey,1997). The uninjured bulb contains colour-less, odour less water-soluble amino acids allin on crushing the garlic bulb, the enzyme allinase breaks down allin to produce Allicin of which the principal ingredient is the odoriferous diallyl-disulphide is reported to be major flavouring component in garlic.

Garlic has attracted particular attention because of its widespread use around the world & the cherished beliefs many have had that it has kept them healthy, helped them toward off illnesses & given them more vigour.Scientists today have been

validating many of the ancient remedies, particularly garlic, determining the identity of the active components, establishing their mechanisms of action, exploring interaction with other active agents from foods & drugs & finding ways to improve bio availability under ordinary conditions of use.

Natural products are an excellent starting point for drug discovery. Medicinal plant extracts and related products, have long been used to treat a wide range of infections including viral infection, and their purified phyto constituents are an excellent precursor for new antiviral drugs (Ganjhu et al., 2015; Lin et al., 2014). For many plant extracts inhibitory activity of replications of various viruses have been reported; namely herpes simplex virus-2 (HSV-2), human immunodeficiency virus-1 (HIV-1), hepatitis B virus (HBV) and SARS virus (Mukhtar et al., 2008). Plant extracts have also shown broad-spectrum activity against drug resistant viruses which might be linked to their many multifunctional components (Tolo et al., 2006). The mechanism by which these extracts, or their purified constituents, display their antiviral action may vary depending on the virus strains and viral life cycle including viral entry, fusion, replication, assembly and virus–host-specific interactions (Lin et al., 2014). Immunomodulatory properties are one the potential activity of herbal medicine products that can fight viral infections. Several plants have shown to enhance the immune system of the host to boost its antiviral defence (Raza et al., 2015). Therefore, plants might be an exciting source for the development of new antiviral drug 3

MATERIALS AND METHODS

The experiment was carried out during Rabi season, 2021-22 at horticulture farm, Kulbhaskar Ashram Post Graduate College Prayagraj. There were 12 treatment combinations laid out in Randomized Block Design (RBD) with three replication. The treatments viz T_1:control (NPK) T_2 :100 % FYM @ 24 t ha^{-1} + Bio-Fertilizer T_3:100 % Vermi-compost @ 6 t ha^{-1} T_4:100 % Farm yard manure @ 24 t ha-1 T_5:100 % Vermi-compost @ 6 t ha^{-1}+ Bio- Fertilizer T_6:50 % Inorganic fertilizer + 50 % FYM @ 12 t ha^{-1} T_7:50 % Vermi-compost 3 t ha^{-1}+ 50 % FYM @ 12 t ha^{-1}+Bio-Fertilizer T_8 :50 % Inorganic fertilizer + 50 % FYM 12 t ha^{-1} + Bio-Fertilizer T_9 :100 % Inorganic fertilizer + Bio-Fertilizer T_{10} :100 % Inorganic fertilizer T_{11} :50 % Inorganic fertilizer + 50 % vermi-compost @ 3 t ha^{-1}+ Bio- Fertilizer T_{12} :50 % Inorganic fertilizer + 50 % vermi-compost @ 3 t ha^{-1} variety of garlic (G-323)was used and maintained 15 cm row to row and 10 cm plant to plant spacing using, 500kg/ha seed rate, before sowing seed were treated with bio-fertilizer (Azospirillum) viz. Allium sativum as per treatment recommendation. The variety was used as the test crop. As per the treatment vermin-compost, farmyard manure and with Bio-fertilizers were applied as soil basal application. All the treatments are applied with Bio-fertilizers, viz, Azospirillum @700PPM . The inorganic fertilizer, applied through N:P:K; Nitrogen was incorporated in three split, 1/3 part at planting time and remaining dose of 2/3 nitrogen as per treatment was applied in two equal splits at 30 days and 45 days after planting with irrigation through urea. Azospirillum was applied through treatment of cloves (garlic)

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Growth characters :

Plant height (cm)

Data (table 1) show that significantly increment in highest plant height (27.87, 56.67, 69.04, 69.32 cm) at 30 DAP, 60 DAP, 90 DAP ,120 DAP treatment which was significantly lowest the . treatment T_1 and found to be at par with the

treatments T_4,T_3,T_{11},T_{10},T_8,The treatment T_9 (100 % Inorganic fertilizers +Azospirillum) was followed by treatments ,T_4 (100 % FYM @ 24 t ha^{-1}) ,T_3 (100 % Vermi-compost @ 6 t ha-1) T_{11} (50 % Inorganic fertilizer + 50 % Vermi-compost + Azospirillum) and T_{10} (100 % Inorganic fertilizer),T_8 (50 % Inorganic fertilizer + 50 % FYM +Azospirillum) . Lowest plant height per plant was observed in the treatment T_1 control. The better plant height be due to better development of bulb which help in uptake of nutrient as well as more availability of nutrients. **Shashidhar et al. (2009) ,** and **Ahmed et al. (2013)**

Table - 1 : Plant Height as Influenced by Integrated Nutrient Management of Garlic

Treatments	Plant height (cm)			
	30 DAP	60 DAP	90 DAP	120 DAP
T1: control	26.14	44.82	50.87	50.96
T2: 100 % FYM + Azospirillum	27.13	50.07	57.48	57.66
T3: 100 % Vermi -compost @ 6 t ha-1	27.05	48.80	56.58	56.82
T4: 100 % FYM @ 24 t ha-1	26.93	48.09	54.80	55.00
T5:100% Vermi -compost+Azospirillum	27.44	52.61	60.34	60.96
T6: 50 %Inorganic fertilizer+50%FYM	27.30	51.43	57.94	58.32
T7: 50 % Vermi -compost + 50 % FYM + Azospirillum	27.37	51.75	59.38	59.64
T8:50 % Inorganic fertilizer +50 % FYM + Azospirillum	27.73	54.83	65.66	66.30
T9:100%Inorganic fertilizers + Azospirillum	27.87	56.67	69.04	69.32
T10: 100 % Inorganic fertilizer	27.65	53.87	63.84	64.06
T11 :50 % Inorganic fertilizer + 50 % Vermi -compost + Azospirillum	27.75	54.95	67.16	67.72
T12: 50 % Inorganic fertilizer + 50 % Vermi -compost	27.53	53.39	61.58	61.97
S. Ed. (±)	1.240	2.636	2.636	2.636
C. D. (P = 0.05)	2.560	5.442	5.442	5.442

Number of leaves per plant

Data (table 2) show that significantly increment in highest number of leaves per plant (0.38,0.91,1.18,1.25) at 30 DAP, 60 DAP, 90 DAP, 120 DAP, treatment T_1(control),which was significantly superior over the treatment T_4, T_3, T_{11}, T_{10}, T_8 , The treatment T_9 (100%Inorganic fertilizers+ Azospirillum) was followed by treatments T_4 (100 % FYM @ 24 t ha^{-1}) and T_3 (100 % Vermi-compost @ 6 t ha^{-1}) and T_{11} (50 % Inorganic fertilizer + 50% Vermi-compost + Azospirillum) ,and T_8(50 % Inorganic fertilizer +50 % FYM + Azospirillum). Lowest number of leaves per plant was observed in the treatment T_1 control. The result obtained in present study are supported by the findings of **Gowda et al. (2007),Shashidhar et al. (2009)** and (Reddy and Reddy, 2005) in garlic

Treatment	*Number of leaves plant-1*			
	30 DAP	**60 DAP**	**90 DAP**	**120 DAP**
T1: control	3.17	4.42	5.55	5.48
T2: 100 % FYM + *Azospirillum*	3.53	5.74	6.67	6.58
T3: 100 % Vermi-compost @ 6 t ha-1	3.47	5.66	6.55	6.50
T4: 100 % FYM @ 24 t ha-1	3.39	5.54	6.47	6.44
T5: 100 % Vermi-compost + *Azospirillum*	3.87	6.12	7.25	7.19
T6: 50 % Inorganic fertilizer + 50 % FYM	3.65	5.88	6.89	6.86
T7: 50 % Vermi-compost + 50 % FYM + Azospirillum	3.77	5.98	7.07	7.04
T8: 50 % Inorganic fertilizer + 50 % FYM + *Azospirillum*	4.25	6.54	7.63	7.60
T9: 100 % Inorganic fertilizers + *Azospirillum*	4.53	6.98	7.99	7.96
T10: 100 % Inorganic fertilizer	4.17	6.42	7.47	7.44
T11 :50 % Inorganic fertilizer + 50 % Vermi-compost + *Azospirillum*	4.33	6.68	7.78	7.76
T12: 50 % Inorganic fertilizer + 50 % Vermi-compost	4.05	6.28	7.35	7.34
S. Ed. (±)	0.290	0.577	0.577	0.577
C. D. (P = 0.05)	**0.599**	**1.190**	**1.190**	**1.190**

Table - 2 : Number of Leaves per Plant as Influenced by Integrated Nutrient Management of Garlic

Neck thickness

The Neck thickness of Garlic is influenced by different treatment combinations of organic, inorganic and bio-fertilizers are presented in Table 3 (0.38 , 0.91, 1.18, 1.25 cm) at 30 DAP, 60 DAP, 90 DAP , 120 DAP treatment T_9 (100 % Inorganic fertilizers + Azospirillum), which was significantly superior over the treatment . T_4,T_3,T_{11},T_{10},T_8, The treatment T_9 (100 % Inorganic fertilizers +Azospirillum) was followed by treatments T_4 (100 % FYM @ 24 t ha^{-1}) and T_3 (100 % Vermi-compost @ 6 t ha^{-1}) and T_{11}(50 % Inorganic fertilizer + 50 % Vermi-compost +Azospirillum) , and T_8 (50 % Inorganic fertilizer + 50 % FYM +Azospirillum) . Lowest number of leaves per plant was observed in the treatment T_1 (0.31) control .

Treatment	Neck thickness (cm)			
	30 DAP	**60 DAP**	**90 DAP**	**120 DAP**
T1: control	0.31	0.58	0.76	0.78
T2: 100 % FYM + Azospirillum	0.34	0.69	0.91	1.10
T3: 100 % Vermi-compost @ 6 t ha-1	0.33	0.67	0.88	0.91
T4: 100 % FYM @ 24 t ha-1	0.32	0.65	0.86	0.88
T5: 100 % Vermi-compost + Azospirillum	0.35	0.77	0.99	1.13
T6: 50 % Inorganic fertilizer + 50 % FYM	0.34	0.79	0.97	0.96
T7: 50 % Vermi-compost + 50 % FYM +Azospirillum	0.35	0.75	0.96	0.98
T8: 50 % Inorganic fertilizer + 50 % FYM +Azospirillum	0.37	0.86	1.40	1.17
T9: 100 % Inorganic fertilizers + Azospirillum	0.38	0.91	1.18	1.25
T10: 100 % Inorganic fertilizer	0.37	0.84	1.08	1.11
T11 :50 % Inorganic fertilizer + 50 % Vermi-compost + Azospirillum	0.38	0.88	1.16	1.20
T12: 50 % Inorganic fertilizer + 50 % Vermi-compost	0.36	0.81	1.06	1.09

Table - 3 : Length of Leaves per Plant as Influenced by Integrated Nutrient Management of Garlic

CONCLUSION

On the basis of present investigation it can be concluded that the integration of 100% inorganic fertilizer with bio-fertilizer (Azospirillum) followed by 50 % inorganic fertilizer + 50 % Vermi-compost + bio- fertilizer (Azospirillum) influenced the more growth, yield and garlic (Nitrogen, Phosphorus, Potassium content in bulb). Integration of inorganic fertilizer with bio fertilizer (Azospirillum) and organic manure (Vermi-compost & Farm yard manure) also gave higher economics (net profit and B : C ratio).

REFERENCES

1. Shashidhar TR, Mannikeri IM and Chavan ML. 2009. Influence of different organic manures on growth and yield of garlic (Allium sativum). J. of Ecobiology. 25 (3):235- 239.
2. Kumar Amit, Kumar Sandeep, Kumar Anuj and Singh KV. 2013. Response of different organic and inorganic fertilizers on growth and yield of garlic (Allium sativum L.). Haryana J. of Agron. 29 (1/2):77-79
3. Ranjan JKN,Ahmed, B. Das and Pragya Hare Krishna 2010. Effect of bio- fertilizers in combination with reduced dose of fertilizers on growth and yield of garlic at high altitude of north-west Himalayas. Indian J. of Horti., 67:263-267.
4. Reddy KC and Reddy KM. 2005. Differential levels of vermi-compost and nitrogen on growth and yield in onion (Allium cepa L.) - radish (Raphanus sativus L.) cropping system. J. Res. ANGRAU. 33 (**1**): 11- 17.
5. Gowda MC, Vijaya kumar M and Gowda APM.2007.Influence of integrated nutrient management on growth, yield and quality of garlic (*Alliumsativum* L.) cv. G-282.Crop Res.Hisar.33(1/3):144-147.

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EFFECT OF GENOTYPES, AGE OF SEEDLINGS AND TRANSPLANTING SPACES ON PLANT GROWTH, ROOT DEVELOPMENT, GRAIN YIELD AND ECONOMICS / NET PROFIT UNDER SYSTEM OF RICE INTENSIFICATION (SRI)

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ABSTRACT

A field experiment was conducted at KVK Instructional Farm and farmers' field of District- Ambedkar Nagar, Uttar Pradesh, India to find out optimum age of seedlings and transplant spacing as well as economics/net profit of rice genotypes under system of rice intensification (SRI) production technology during Kharif 2018 and 2019, respectively. The experimental materials consists two different genotypes viz. BPT 5204 as high yielding variety and RPH 6 as hybrid of Rallis India; two age of seedlings viz. 10 days and 12 days as well as two transplanting spaces viz. 25×25 cm and 30×30 cm. Among two rice genotypes, RPH 6 was recorded higher yielder than BPT 5204. As well, transplanting of 10 days old seedlings with plant geometry of 25 × 25 cm produced significantly better plant growth, root development, higher grain yield and economics/ net profit during both the years of experimentation. The optimum level of plant population coupled with better yield attributing traits might have resulted in higher grain yield and economics/ net profit under SRI studies in Eastern Uttar Pradesh, India.

Keywords : *SRI, age of seedlings, transplanting spaces, grain yield, economics/net profit.*

INTRODUCTION

Rice (*Oryza sativa* L.) is the second most important cereal crop in the world and is more distributed and cultivated in the Asian continent including India. Globally, India that stands as numero uno in acerage (43.86 million hectares) is second to China in production annually 104.80 million tonnes with 2390 Kg/ha average productivity (Anonymous, 2018) and meets about 29.9 per cent of the total calories needs its populace(Timmer, 2010). Among four rice ecologies viz. irrigated lowlands, rain-fed lowlands, rain-fed uplands and deep water rice, irrigated lowland is most favourable both in terms of its share in total acreage (55.9%) and production (75%) of the country. To feed growing population, India has to produce about 130 million tonnes of rice by 2025(Gangaih *et al*., 2014).Uttar Pradesh is the

second largest producer state after West Bengal with annual production of 12.5million tonnes from an area of 5.86 million hectares. The average productivity of Uttar Pradesh state is 2.35 tonne per hectare which was much below the national level of rice productivity. The major constraints of rice production in Uttar Pradesh are low coverage of HYVs and Hybrids, soil salinity / alkalinity and nutrient deficiencies, imbalanced fertilizer use, decreasing soil organic matter (SOM) content, changing climatic conditions resulted flash floods, sub-mergence and drought, very low seed replacement rate(SRR) and shortage of farm labours. The possibility of doubling rice yield in Asian and African countries through adoption of SRI (Uphoff, 2004), 35.6 % higher yield of SRI Super-1 hybrid rice as 16.0 ton/ha in China (Yuan,2002) and the reported world record yields of SRI as 22.4 ton/ha in Nalanda district, Bihar, India during 2011shows the potential of technology in enhancing rice productivity. The SRI was introduced in the National Food Security Mission (NFSM) as a method to improve rice production in India including Uttar Pradesh since 2006 (Gangaih *et al.*, 2014).

Puddled transplanted rice (TPR) cultivation in irrigated ecologies *i.e*. in-efficient in water use (4000-5000 litre water/ Kg grain or 2 calories/ litre water use) is gradually losing its place in cropping systems. Water needs of rice production are 2-4 times more than that of other crops of the same duration because of water loss by percolation, seepage, field preparation etc. under sub-merged conditions (Sita Devi and Ponnasiri, 2009). To assure food security in the rice consuming countries of the world including India, rice production would have to be increased by 50% in these countries by 2025 and this additional yield will have to be produced on less land with less usage of water, labour and chemicals(Zeng *et al.,*2004). Also, the main threats to the future food securityand shrinking land,depleting water resources, declining trends in soil fertility and productivity as well as depletion of ground water table (Sita Deviand Ponnasiri,2009). In recent years, several strategies viz. Direct seeded rice (DSR), alternate wetting and drying(Tabbal *et al.*, 2002) and SRI have been tried (Uphoff, 2003 and 2004) for productivity of rice in India.Changing climatic situations coupled with inadequate monsoon, rainfall, lack of water harvesting measures and improper use of irrigation water has brought down water table in many countries including India. The alarming situation limits the scope for rice cultivation. In Asia, 17 million hectare of irrigated rice area may experience "physical water scarcity"and 22 million hectare may have "economic water scarcity" by 2025(Tuong and Bouman, 2001).

Seedling age is well known to influence the rice grain yield (Singh et al., 2004). Transplanting of younger rice seedlings assumes special significance and principal means in obtaining higher yields in SRI cultivation. Enormous loss in growth potential of rice seedlings was observed if they are transplanted more than 14 days age of seedlings. It means seedlings should be transplanted before 4th phyllochron or stage of single tiller per hill. This stage usually occurs in two weeks after sowing of seed in the nursery(Rafaralahy, 2002). Wider transplanting space promotes higher tiller potential and better root growth. Working of rotary cono-weeder churns the soil and provides greater aeration which helps in build-up of enormous microbial growth thereby enhancement of nutrient supply which ultimately results in health plant growth, root development as well as higher yields and economics/net profit at lower cost.There is an urgent need to develop /search for alternate method of rice production which requires less water without affecting the yield potential of the varieties. System

of Rice Intensification (SRI) is a water saving technology with many fold increase in crop yield through modifying management practices such as controlled supply of water, planting of younger seedlings and providing wider space. The enhanced yields of SRI coupled with the reduced cost of cultivation (as saving in seed, irrigation, labour cost etc.) translate into greater profits that vary with situation. This technology also protectsoil, save environment by checking Methane gas(CH_4) emission from the sub- merged paddy fields and reduces external input cost(Laulanie,1993).

MATERIALS AND METHODS

The experimental detail shows two genotypes viz. BPT - 5204 as HYV (G_1) and RPH - 6 as hybrid (G_2), two different age of seedlings *viz*. 10days (A_1) and 12 days (A_2) as well as two transplanting spaces *viz*. 25 cm x 25 cm (S_1) and 30cm x 30cm under Split Plot Design in three replications. The area of one plot was 9m x 6m=54m^2, area of one replication 54m^2 x 8=432m^2 and total area of three replications 432 m^2x3=1296m^2.

The soil of experimental plots/ fields was sandy loam in texture and slightly alkaline in nature having pH 7.1 with good organic matter and water holding capacity. The previous crop was field pea cv.Malviya Pea-15 during 2017-18 for Kharif 2018 trial and Chick pea cv. Pant Gram-186 during 2018-19 for Kharif 2019 trial at KVK instructional farm as well as wheat during Rabi 2017-18 for Kharif 2018 at first farmers' field and follow land during Rabi 2018-19 atsecond farmers'field. To maintain soil fertility level of experimental area, recommended dose of Farm Yard Manure @150q/ha was applied uniformly in the soil before ploughing, levelling and piddling. Neem cake@100 kg/ha also applied as top dressing for management of diseases and insect pests during both the test years.

Paddy genotypes recommended for drought prone area such as BPT-5204 and hybrid RPH-6 are most suitable under SRI crop production. Seed material of test genotypes was soaked for 24 hours and incubated in moist gunny bags for next 24 hours for germination. Initial germinated seeds were sown uniformly on nursery beds. After sowing, soil: FYM (1:1) mixture was spread thoroughly on seeds.The nursery beds were irrigated during evening to maintain moisture in seed-bed soil. Before lifting the seedlings, nursery beds were irrigated thoroughly. Such seedlings were immediately transplanted within30 minutes of time in the main field under cloudy weather or preferably during evening as per recommendation of SRI technology as single seedling per hill with the help of round marker having 25cmx25cm and 30cmx30cm plant geometry. After 10 days of seedling transplantation, manual cono-weeder was applied for the first time in east-west direction and other three times at an interval of 10 days with cross formation in north-south as well asagain east-west and north-south direction with development of square hills under sub-merged condition of 8-10 cm water in the field for churning of soil. The young plants absorb available nutrients from soil-water solution. The observations on plant height, root spread, root depth, root biomass, number of tiller/hill, number of spike/hill, spike length, days to 50% flowering, number of grain/spike, test weight as 100seed weight, grain yield and economics/net profit were recorded. The data were analysed statistically in split plot design as per web portal www web Agri State Package 2.0.

RESULTS AND DISCUSSION

The observations recorded on plant growth, root development, yield attributing traits and economics/net profit were predicted in Table 1 to Table 4.

Effectofgenotypes: A suitable cultivar or genotype plays major role in better plant growth and higher

yield of a crop. The significant effect of genotypes was recorded on plant height during 2018 at KVK instructional farm as well as number of tillers and spike per hill, spike length, days to 50% flowering, grain yield and economics/net profit during 2018 at KVK farm and farmers' fields both. The test weight and number of grain per spike also significantly influenced with genotypes during 2018 and 2019 except number of grain per spike which performed non-significant effect during 2019 at farmers' field.

Hybrid paddy cv. RPH-6 was significantly superior than HYV cv. BPT-5204 under SRI method of crop establishment in case of plant height, root spread, root depth, root biomass, spike length, test weight, number of grain per spike, grain yield and economics/net profit during Kharif 2018 and 2019 at KVK farm and farmer's fields.HYV paddy cv. BPT-5204 showed significant effect on number of tillers per hill and number of spikes per hill as well as days to 50% flowering. Similar trend was also reported by Thakur *et al.* (2009).

Effectofageofseedlings: Seedlingageiswellknownt o influence plant growth and grain yield of paddy. The number of tillers and number of spikes per hill varied significantly due to age of seedlings at different growth stages of the crop. Ten days age of seedlings performed higher results in almost all test parameters under SRI experiments during Kharif 2018 and 2019 at KVK farm and farmer's fields. It means 10 days old seedlings provided better plant height, root development, yield attributing traits and economics/net profit in the present investigation. Twelve days age of seedlings significantly influenced days to 50% flowering only in the trials. The present findings are in conformity with the results of Laulanie (1993), Singh et al. (2004) and Shreedhar and Ganesh(2019).Contradictory to present findings that Singh *et al.*(2017) reported 12 days old seedlings was most suitable under SRI method of rice cultivation in agro climatic of eastern Uttar Pradesh.

Effectoftransplantingspaces: A wider spacing of rice transplant provides more opportunity for better root development and nutrients absorption due to more solar radiation and photosynthesis process. The transplanting space of 25cmx25cm influenced plant height, root depth, spike length, number of tillers and spikes per hill,number of grain per spike,grain yield and economics/net profit. This plant geometry promotes optimum plant population, less chaffy grains/spike along with higher number of tillers per hill. Similar findings were also reported by Laulanie (1993), Narayana and Reddy (2002),Cessay and Uphoff(2003), Zhang *et al.*(2004), Shreedhar and Ganesh (2010) and Singh *et.al*. (2017). while,Dass and Chandra (2012) reported 56.2% higher net return in SRI than conventional rice crop production at Pant Nagar.

The more wider spacing i.e. 30 cmx30cm showed less tillers and spikes in per unit area but supported to superior root spread, root biomass, days to 50% flowering and test weight. The significant effect of transplanting space was recorded on root spread during 2018 at KVK farm only. Other parameters such as number of tillers per hill, spikes per hill and days to 50% flowering also showed significant results during 2018 at KVK farm and farmer's field whereas grain yield and economics/net profit also significantly influenced during 2018 and 2019,respectively at both the locations except Kharif 2018 at farmer's field in the present investigation.

Interactioneffect of genotypes and age of seedlings: Thisinteraction significantly influenced grainyieldduring2019atKVKfarm**.**Otherparameters showed non-significant interaction effect.

Interaction effect of genotypes and transplanting spaces: Thisinteraction significantly increased spike length during 2018 at farmer's field. Other parameters exhibited non-significant interaction

Table - 1 : Effect of genotypes, age of seedlings and transplanting spaces on plant height, root spread and root depth.

Treatments	Plant Height (cm)					Root Spread (cm)					Root Depth (cm)				
	2018		2019		Mean	2018		2019		Mean	2018		2019		Mean
	KVK Farm	Farmers' Field	KVK Farm	Farmers' Field		KVK Farm	Farmers' Field	KVK Farm	Farmers' Field		KVK Farm	Farmers' Field	KVK Farm	Farmers' Field	
Main Plot= Genotypes (G)															
G_1	85.74	84.27	67.23	67.19	76.11	22.00	22.02	20.49	20.60	21.28	25.75	24.29	23.02	22.53	23.89
G_2	90.20	88.39	80.75	81.27	85.15	22.49	21.81	22.09	21.45	21.96	27.27	25.28	25.28	23.73	25.39
SEm (±)	0.62	0.89	0.93	0.46		0.39	0.48	0.47	0.68		0.28	0.45	0.59	0.32	
CD at 5%	3.85	NS	5.71	2.86		NS	NS	NS	NS		NS	NS	NS	NS	
Sub plot=Age of seedling (A)															
A_1	87.75	85.42	74.69	75.39	80.81	22.15	21.71	21.50	21.90	21.81	26.26	24.63	24.52	24.25	24.92
A_2	88.19	87.24	73.30	73.07	80.45	22.33	22.11	21.08	20.15	21.42	26.76	24.94	23.77	22.00	24.37
SEm (±)	0.74	0.86	0.54	0.75		0.23	0.53	0.38	0.44		0.38	0.46	0.44	0.46	
CD at 5%	NS	NS	NS	2.31		NS	NS	NS	1.342		NS	NS	NS	1.41	
Sub- sub plot= Transplanting Spaces (S)															
S_1	87.84	86.16	74.68	74.95	80.91	21.88	21.58	20.57	20.59	21.16	26.27	24.70	24.12	23.69	24.69
S_2	88.10	86.50	73.31	73.51	80.36	22.60	22.25	22.00	21.46	22.08	26.75	24.87	24.17	22.57	24.58
SEm (±)	0.74	0.86	0.54	0.75		0.23	0.53	0.38	0.44		0.38	0.46	0.44	0.46	
CD at 5%	NS	NS	NS	NS		0.698	NS	1.174	NS		NS	NS	NS	NS	

Table - 2 : Effect of genotypes, age of seedlings and transplanting spaces on root biomass, number of tillers per hill and number of spikes per hill.

Treatments	Root Biomass(cc)					Number of Tillers per hill					Number of Spikes per hill				
	2018		2019		Mean	2018		2019		Mean	2018		2019		Mean
	KVK Farm	Farmers' Field	KVK Farm	Farmers' Field		KVK Farm	Farmers' Field	KVK Farm	Farmers' Field		KVK Farm	Farmers' Field	KVK Farm	Farmers' Field	
Main Plot=Genotypes (G)															
G_1	44879.50	37233.42	30499.01	30798.53	35852.62	55.25	49.83	54.75	56.33	54.04	55.25	49.83	54.33	55.00	53.60
G_2	48427.75	38225.50	39547.42	34544.92	40186.39	34.50	32.42	35.33	35.25	34.38	34.50	32.42	34.67	35.17	34.19
SEm (±)	2089.80	2086.32	2069.11	2823.37		1.42	1.28	0.82	0.62		1.42	1.28	0.77	0.86	
CD at 5%	NS	NS	NS	NS		NS	7.873	5.05	3.795		NS	7.87	4.73	5.28	
Sub plot=Age of seedlings (A)															
A_1	44972.42	36706.08	36082.69	37155.68	38729.22	45.92	41.33	46.33	49.67	45.82	45.92	41.33	45.58	48.67	45.37
A_2	48334.83	38752.83	33963.74	28187.77	37309.79	43.83	40.92	43.75	41.92	42.61	43.83	40.92	43.42	41.50	42.42
SEm (±)	2327.91	2330.72	1861.98	1452.83		1.44	1.23	0.71	0.94		1.44	1.23	0.62	0.94	
CD at 5%	NS	NS	NS	4475.75		NS	NS	2.18	2.89		NS	NS	1.90	2.88	
Sub sub-plot = Transplanting Spaces (S)															
S_1	46240.58	36399.00	32747.87	32158.22	36886.42	47.17	43.67	48.83	47.58	46.81	47.17	43.67	47.83	46.92	46.39
S_2	47066.67	39059.92	37298.56	33185.23	39152.59	42.58	38.58	41.25	44.00	41.60	42.58	38.58	41.17	43.25	41.39
SEm (±)	2327.91	2330.72	1861.98	1452.83		1.44	1.23	0.71	0.94		1.44	1.23	0.62	0.94	
CD at 5%	NS	NS	NS	NS		NS	3.79	2.19	2.89		NS	3.79	1.90	2.88	

Table - 3 : Effect of genotypes, age of seedlings and transplanting spaces on spike length, days to 50% flowering and test weight.

Treatments	Spike Length (cm)					Days to 50% Flowering					Test Weight (g per 100 seed)				
	2018		2019		Mean	2018		2019		Mean	2018		2019		Mean
	KVK Farm	Farmers' Field	KVK Farm	Farmers' Field		KVK Farm	Farmers' Field	KVK Farm	Farmers' Field		KVK Farm	Farmers' Field	KVK Farm	Farmers' Field	
Main Plot=Genotypes(G)															
G_1	53.98	52.44	50.33	50.01	51.69	91.67	92.50	93.75	94.50	93.11	17.68	17.22	14.34	14.19	15.86
G_2	66.42	64.91	62.87	62.15	64.08	63.83	67.50	65.92	69.50	66.69	24.65	24.10	24.83	24.81	24.59
SEm (±)	0.44	0.56	0.38	0.45		0.26	0.31	0.21	0.30		0.37	0.31	0.14	0.06	
CD at 5%	NS	3.43	2.37	2.78		NS	1.89	1.31	1.89		2.30	1.91	0.85	0.39	
Sub plot=Age of seedlings(A)															
A_1	60.05	57.93	57.60	57.39	58.24	77.50	79.83	79.58	81.42	79.58	21.09	20.58	19.67	19.70	20.26
A_2	60.35	59.41	55.60	54.77	57.53	78.00	80.17	80.08	82.58	80.21	21.24	20.75	19.50	19.30	20.19
SEm (±)	0.35	0.39	0.36	0.30		0.47	0.31	0.50	0.31		0.13	0.11	0.11	0.10	
CD at 5%	NS	1.22	1.11	0.93		NS	NS	NS	0.95		NS	NS	NS	0.32	
Sub sub plot=Transplanting spaces(S)															
S_1	60.57	58.86	57.42	57.19	58.51	76.75	79.00	78.83	81.33	78.98	21.01	20.60	19.64	19.62	20.22
S_2	59.83	58.49	55.78	54.97	57.27	78.75	81.00	80.83	82.67	80.81	21.32	20.73	19.54	19.38	20.24
SEm (±)	0.35	0.39	0.36	0.30		0.47	0.31	0.50	0.31		0.13	0.11	0.11	0.10	
CD at 5%	NS	NS	1.11	0.93		NS	0.95	1.54	0.95		NS	NS	NS	NS	

Table - 4 : Effect of genotypes, age of seedlings and transplanting spaces on number of grains per spike, grain yield and economics/net profit.

Treatments	Number of Grains per spike					Grain Yield (Kg per ha)					Economics/Net Profit (Rs/ha)				
	2018		2019		Mean	2018		2019		Mean	2018		2019		Mean
	KVK Farm	Farmers' Field	KVK Farm	Farmers' Field		KVK Farm	Farmers' Field	KVK Farm	Farmers' Field		KVK Farm	Farmers' Field	KVK Farm	Farmers' Field	
Main Plot=Genotypes(G)															
G_1	276.83	258.50	308.08	276.50	279.98	5481.48	5513.98	5564.53	5803.74	5590.93	22780.50	23200.42	32974.17	35258.08	28553.29
G_2	323.00	302.00	275.17	260.33	290.12	6938.27	6712.75	5641.13	5943.70	6308.96	34603.92	33246.42	33583.00	36699.50	34533.21
SEm (±)	5.97	4.05	0.79	4.16		138.56	156.31	282.32	108.86		966.93	552.89	2908.00	1121.51	
CD at 5%	36.83	24.99	4.89	NS		854.83	964.34	NS	NS		5965.3	3410.98	NS	NS	
Sub plot=Age of seedlings(A)															
A_1	300.67	276.42	296.25	279.50	288.21	6105.71	6090.33	6137.67	6472.41	6201.53	28086.42	28664.25	38697.42	42145.33	34398.36
A_2	299.17	284.08	287.00	257.08	281.83	6314.04	6136.40	5067.99	5275.02	5698.36	29298.00	27782.58	27679.75	29812.25	28643.15
SEm (±)	3.05	2.97	3.53	3.97		186.55	147.95	108.91	186.98		1662.85	794.72	1121.73	1925.92	
CD at 5%	NS	NS	NS	12.23		NS	NS	335.52	576.05		NS	NS	3455.74	5933.22	
Sub sub plot=Transplanting Spaces(S)															
S_1	300.33	281.42	300.58	273.58	288.98	6527.00	6290.34	5989.51	6166.47	6243.33	31108.08	31197.67	37171.33	38994.08	34617.79
S_2	299.50	279.08	282.67	263.25	281.12	5892.74	5936.39	5216.15	5580.97	5656.56	26276.33	25249.17	29205.83	32963.50	28423.71
SEm (±)	3.05	2.97	3.53	3.97		186.55	147.95	108.91	186.98		1662.85	794.72	1121.73	1925.92	
CD at 5%	NS	NS	10.89	NS		574.70	NS	335.52	576.05		NS	2448.32	3455.74	5933.22	

effect.

Interactioneffectof genotypes, age of seedlings and transplanting spaces: This interaction significantly influenced number of grain per spike during 2018 as well as grain yield and economics/net profit during 2019 at KVK farm.Otherparameters also showed non-significant interaction effect.

REFERENCES

1. Anonymous. 2009. Background note for consultation meeting with policy makers on review of National Water Policy. Ministry of Water Resources, P. 50.
2. Anonymous. 2018. Area, Production and Productivity of rice in India and Uttar Pradesh. Directorate of Economics and Statistics,Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India.
3. Cessay, M.M. and Uphoff, N. 2003. The effect of repeated soil wetting and drying on lowland rice yield with systemof rice intensification (SRI) methods. In:http://ciifad/cornell.edu.
4. Dass, A. and Chandra, S.2012. Effect of different components of SRI on yield, quality, nutrient accumulation and economics of rice (*Oryzasativa* L.) in *tarai* belt of northern India. *IndianJournalofAgronomy*, 57 (3):250-254.
5. Gangaiah, B., Mahender Kumar, R., Sreedevi, B., Prasad Babu, MMB. 2014. System of rice intensification (SRI): A good agricultural practice for enhanced productivity and profits. *A training manual on Bio-intensive IPM for riceincluding SRI organized by NIPHM, Hyderabad*, pp 91-94.
6. Laulanie H. 1993. Systeme de rigiculture intensive malagache. *Tropicultura* (Brussels);11:104-114.
7. Narayana Reddy, L. 2002. SRI method of paddy cultivation. *LeisaIndia* 11:28-29
8. Rafaralahy, S. 2002. An NGO perspective on SRI and its origin in Madgaskar. In: Assessment of the System of Rice Intensification(SRI).*Proc. Intl. Conf. Sanya, China*, pp. 17-22.
9. Shreedhar, M. and Ganesh, M.2010. Studied on influence of age of seedlings and spacing on seed yield and quality under system of rice (*Oryzasativa* L.) intensification. *Journal of Research ANGRAU,* 38(1&2):103-107
10. Singh, K.K., Yadav, S.K., Tomar, B.S., Singh, J.N. and Singh, P.K.2004. Effect of seedling age on seed yield and seed quality attributes in rice cv. Pusa Basmati-1. *Seed Research*; 32:5-8.
11. Singh, S., Kumar,V., Sagar,V., Maurya, M.L. and Khan,A.W.2017.Effect of age of seedling and plant spacing on yield and attributing traits of rice varieties under SRI method of rice cultivation. *Journalof Pharmacognosy and Phytochemistry*. 798-801.
12. Sita Devi, K. and Ponnasiri, T. 2009. An economic analysis of modern rice production technology and its adoption in Tamil Nadu. *Agricultural Economics Research Review*; 22: 341-347.
13. Tabbal, D.F., Boumam, B.A.M., Bhojan, S.I., Sibayan, E.B. and Saffar, M.A. 2002. On-farm strategies for reducing water input in irrigated rice. Case studies in the Philippines. *Agricultural Water Management*, 56: 93-112.
14. Thakur, A.K., Chaudhari, S.K., Singh, R. and Kumar, A. 2009. Performance of rice varieties at different spacing grown by the system of rice intensification eastern India. *IndianJournalofAgricultureScience*. 79(6):443-447.
15. Timmer, C.P. 2010. The changing role of rice in Asia's food security. *ADB Sustainable Development Working Paper SeriesNo*. 15:

p.18

16. Tuong, T.P. and Bouman, B.A.M. 2001. Rice production in water-scarce environments. Paper presented in the *WaterProductivity Conference,* Colombia, Sri Lanka.
17. Uphoff, N.2003. Higher yields with fewer external inputs. The system of rice intensification and potential contributions to agricultural sustainability. *International Journal of Agricultural Sustainability*; 1(1):38-50.
18. Uphoff, N.2004. System of rice intensification responds to 21'st century needs. *Rice Today*, 3(3): 42.
19. Yuan, L.P.2002. A Scientist's perspective on experience with SRI in China for raising the yields of super hybrid rice. http://ciifad.cornell.edu/sri/procl/sri06.pdf.
20. Zeng, J.,Lu, X., Tang, X. and Tang, Y. 2004. The system of rice intensification (SRI) for super –high yields of rice in Sichuan basin. *Fourth International Crop Science Congress*, Brisbane Australia, in: http://www.ciifad.cornell.edu/sri/countries.
21. Zhang, J., Xianjun, L., Xilnlu, J. and Tang, Y. 2004. The system of rice intensification for super high yields of rice in Sichuan basin. *Journal of South China Agriculture University*, 26: 10-12.