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Effect of Precision Application of Nutrients on, Growth, Yield, Quality and Nutrient Use Efficiency in Tomato (*Solanum lycopersicum* L.) Cv. Pearson

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ABSTRACT

The investigation was conducted to study the Effect of precision application of nutrients on yield, quality and nutrient use efficiency in tomato (cv. Pearson). The experiment was carried out at Bolan Research Farm, Helmand, Afghanistan during the year 2021. The experiment was laid out in (RCBD) designed having three replications, each replication consisted of 10 treatments. The treatments comprised of T_1: Fertilizers Urea + DAP + MOP (140:60:60 kg/ha), T_2: Fertilizers Urea + DAP + MOP (70:30:30 kg/ha), T_3: Fertilizers + Nutrient Solution Urea + DAP + MOP + NPK + Urea (70:30:30 + 70:30:30), T_4: Fertilizers + Nutrient Solution Urea + DAP + MOP + MAP + Urea + MOP (70:30:30 + 70:30:30), T_5: Fertilizers + Nutrient Solution Urea + DAP + MOP + NPK + Urea (70:30:30 + 55:24:24), T_6: Fertilizers + Nutrient Solution Urea + DAP + MOP + VAM MAP + Urea + MOP (70:30:30 + 55:24:24), T_7: Fertilizers + Nutrient Solution Urea + DAP + MOP + NPK + Urea (70:30:30 + 42:18:18), T_8: Fertilizers + Nutrient Solution Urea + DAP + MOP + VAM MAP + Urea + MOP (70:30:30 + 42:18:18), T_9: RDF Urea + DAP + MOP (137.5:62.5:60) and T_{10}: Control (No fertilizer). The result confirmed that integrated application of nutrient significantly affected all growth, yield and yield traits of tomato hence, the tallest plant (133.33cm), maximum No. of branches plant^{-1} (31.67), No. of fruit plant^{-1} (67.33), large polar diameter (8.33cm), large equatorial diameter (8.33cm), average yield plant^{-1}(6.13 kg), total yield (344.00 q/ha), total soluble content (4.61 %), dry matter content (5.02%) were recorded in the plots were treated with T_8 (Urea + DAP + MOP + VAM MAP + Urea + MOP) (70:30:30 + 42:18:18) except the fruits weight(g) and average fruit weight (g) as compared to other treated plots,. Generally, all fertilized plots showed positive & better performance as compared to control plots (no treated plots). We concluded from the result that all treatments regarding their efficient effect and economical use were ranked as (T_8> T_9> T_7> T_6> T_5> T_4> T_3> T_2> T_1> $T_{Control}$) for all growth, yield and yield characters of tomato (cv. Pearson) in research area.

Keywords- Tomato, Integrated Nutrients Application, Nutrient Use Efficiency, Growth, Yield, Quality.

I. INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is the most popular vegetable crop in the world because of its high nutritive value and versatile uses. It has been reported to be an important source of vitamins, minerals, and antioxidants such as lycopene and phenolic (*Kaur et al*, 2002). Its fruits are eaten raw in salad and processed into various forms such as ketchup, puree, juices, soups, pickles, etc. It is also used in almost all the vegetable cooked in different preparations and add flavor to the foods. In Afghanistan, this vegetable has become a very high-value crop as it fetches high prices when grown under protected conditions such as poly houses and net houses. Tomato is rich from minerals, vitamins, and organic acids and contains total sugar content of 2.5 percent in ripe fruit, ascorbic acid of 16.0-65.0 mg/100 g, 94.1 g of water, 1.0 g of protein, 0.3 g of fat, 4.0 g of

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carbohydrates, 0.6 g of fibers, vitamin A of 1100 I.U, vitamin B 0.20 mg, vitamin C 23 mg. The fruits are also rich in minerals like potassium (K) 268 mg and phosphorus (P) 27 mg (*Kaur et al*, 2002). It is a shallow-rooted crop and hence, is not normally capable of sustaining itself by drawing up the nutrient reserves from deeper soil layers. On the other hand, it is a heavy feeder of nutrients owing to its continuous and simultaneous growth of vegetative and reproductive structures and heavy fruit yield in indeterminate. Nitrogen (N) plays a key role in the nutrition of plants. An adequate amount of nitrogen is also required to obtain a good yield in vegetable crops.

P and K are considered as major nutrient in tomato cultivation which involves all the metabolic process in the plant and there is considerable evidence to show that, this element plays an important role in photosynthesis and helps in building up carbohydrate in the plant. Although the yield potential of a cultivar is largely dependent upon its genetic constitutions, yet is further manipulated with various agronomic factors. Among the various factors influencing the production of tomatoes, nutrition is found to exert a great influence on the growth and yield of tomatoes. Nitrogen is equally said to be the motor of plant growth. Tomato requires an adequate supply of P for optimal development and high yields, severe limitation of P depressed the rate of photosynthesis, starch accumulation, leaf nitrogen concentration, reproductive efficiency (Groot *et al.*, 2001). The soil having high level of P improve pollen grain quality & quantity (Poulton *et al.*, 2001).

Tomateos`s requirement for K are extraordinarily high due to the rapid growth of the plant in combination with the heavy fruit load (Chapagain and Wiesman 2004). Tomato being a heavy feeder and an exclusive crop requires large quantities of inorganic fertilizers. It is reported that a tomato crop yielding 380 quintals of ripe fruits per hectare removes 104 kg N, 22 kg P2O5, and 141 kg K2O/ha. To supply adequate nutrition for optimum plant growth, the physiological stage of development must be considered when adjustments to nutritional regimes are required. It is, therefore, necessary to increase its yield per unit area by using balance fertilizers with the appropriate method (Meena *et al.*, 2012). Nutrient use efficiency can be further improved by the application of nutrients in the soluble form at the root zone along with inorganic fertilizers. The solution supplies readily available nutrients directly to the soil-rhizosphere system. The initial growth of the plants and their roots can be greatly enhanced by this single application of the nutrient solution. It is an effective technique to increase plant dry weight and N, P, and K uptakes, and to promote rapid early growth of crops. This technique is based on an ecological friendly concept and principles for plant nutrient requirements. This provides a new fertilization option other than conventional fertilization (Ma and Kalb, 2004). With this background, the present study was conducted to study the effect of precision application of nutrients on yield, quality, and nutrient use efficiency in tomato (*Solanum lycopersicum* L.) with the following objectives.

II. MATERIALS AND METHODS

The field experiment was carried out to study the effect of precision application of nutrients on yield, quality and nutrient use efficiency on tomatoes growth, yield and yield traits at Bolan research farm, Helmand, Afghanistan which located in southern Afghanistan, situated at 31.5° N latitude and 64.3° E longitude with an altitude of 600 meters above the sea level during Kharif (summer) 2022. The climate and weather conditions of mentioned research area is generally arid to semiarid and the temperature is 36-38 ^{0}C in July and coldest temperature is 0-8 ^{0}C in January with 100 to 200 mm annual rainfall ranges. Summer season starts form July till ends of October. July and August are the hottest months of summer.

The invistigate was laid out in Randomized Complete Block Designed (RCBD) having three replications. Each replication consisted of 10 treatments, with 3m x 2. 5m plot size, 75 cm x 75 cm rows space and 30 cm x 30 cm plant to plant space. Effect of combined treatment such as T_1: Fertilizers Urea + DAP + MOP (140:60:60 kg/ha), T_2: Fertilizers Urea + DAP + MOP (70:30:30 kg/ha), T_3: Fertilizers + Nutrient Solution Urea + DAP + MOP + NPK + Urea (70:30:30 + 70:30:30), T_4: Fertilizers + Nutrient Solution Urea + DAP + MOP + MAP + Urea + MOP (70:30:30 + 70:30:30), T_5: Fertilizers + Nutrient Solution Urea + DAP + MOP + NPK + Urea (70:30:30 + 55:24:24), T_6: Fertilizers + Nutrient Solution Urea + DAP + MOP + VAM MAP + Urea + MOP (70:30:30 + 55:24:24), T_7: Fertilizers + Nutrient Solution Urea + DAP + MOP + NPK + Urea (70:30:30 + 42:18:18), T_8: Fertilizers + Nutrient Solution Urea + DAP + MOP + VAM MAP + Urea + MOP (70:30:30 + 42:18:18), $T_{9:}$ RDF Urea + DAP + MOP (137.5:62.5:60) and T_{10}: Control (No fertilizer). Local tomato variety was used as a test crop. Data on total yield and fruit weight yield was recorded by harvesting time then the average worked out with the following formula.

$$\textbf{Average fruit weight (g)} = \frac{\text{Total weight of fruits (g)}}{\text{Number of fruits}}$$

$$\textbf{Total yield in q/ha} = \frac{\text{Yield}\left(\frac{\text{kg}}{\text{tree}}\right)\times\text{number of tree/ha}}{100\times 10}$$

Statistical analysis

Statistical analysis of data of various characters will be carried out as per Randomized block design. Analysis of variance will be worked out using standard statistical procedures as described by Panse and Sukhatme (1985). Statistical analysis will be carried out in the computer cell, Department of Agricultural Statistics, Helmand University, Helmand.

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III. RESULTS

Growth parameters

Plant height (cm)

Plant height was significantly influenced by application of nutrients at 40, 80 and 120 DAT, which are presented in Table1. Effect of nutrients on plant height was observed significant at 40, 80 and 120 DAT. The data revealed that maximum plant height (66.67 cm) at 40 was noted in T_7 (Urea + DAP + MOP + NPK + Urea and 70:30:30 + 42:18:18 kg/ha), while maximum plant height (105.67 and 133.33 cm) at 80 and 120 DAT were noted in T_8 (Urea + DAP + MOP + MAP + Urea + MOP and 70:30:30 + 42:18:18 kg/ha) which was at par with T_7 (Urea + DAP + MOP + NPK + Urea and 70:30:30 + 42:18:18 kg/ha). Minimum plant height (55.33, 85.33 and 100.67 cm) at 40, 80 and 120 DAT were noted in T_{10} (Control).

Number of branches plant^{-1}

The data on number of branches per plant is statistically analyzed at 40, 80 and 120 DAT and significantly influenced by application of nutrients. The data presented in Table.2 and Revealed that maximum number of branches per plant (10.00, 17.00 and 31.67) at 40, 80 and 120 DAT were noted in T_8 (Urea + DAP + MOP + MAP + Urea + MOP and 70:30:30 + 42:18:18 kg/ha), while minimum number of branches per plant (5.67, 9.33 and 18.33) at 40, 80 and 120 DAT were noted in T_{10} **(**Control). Presented in Table 2.

Table 1. Effect of precision application of nutrients on plant height in tomato (*Solanum lycopersicum* L.)

Treatments	**Plant height (cm)**		
	40 DAT	**80 DAT**	**120 DAT**
T_1 (Urea + DAP + MOP) (140:60:60 kg/ha)	63.67	86.67	101.67
T_2 (Urea + DAP + MOP) **(**70:30:30 kg/ha)	63.00	87.67	118.33
T_3 (Urea + DAP + MOP + NPK + Urea) (70:30:30 + 70:30:30)	61.00	95.00	121.67
T_4 (Urea + DAP + MOP + MAP + Urea + MOP) (70:30:30 + 70:30:30)	57.67	95.67	119.00
T_5 (Urea + DAP + MOP + NPK + Urea) (70:30:30 + 55:24:24)	57.00	91.00	117.67
T_6 (Urea + DAP + MOP + MAP + Urea + MOP) (70:30:30 + 55:24:24)	58.67	95.33	125.33
T_7 (Urea + DAP + MOP + NPK + Urea) (70:30:30 + 42:18:18)	66.67	96.00	125.67
T_8 (Urea + DAP + MOP + VAM MAP + Urea + MOP) (70:30:30 + 42:18:18)	63.67	105.67	133.33
T_9 (Urea + DAP + MOP) (137.5:62.5:60)	63.33	97.33	124.00
T_{10} (Control)	55.33	85.33	100.67
S.Em.±	3.47	2.29	3.74
C.D. at5 %	4.41	9.81	7.89
C.V %	9.75	4.23	5.36

Table 2: Effect of precision application of nutrients on number of branches per plant in tomato (*Solanum lycopersicum* L.)

Treatments	**Number of branches plant^{-1}**		
	40 DAT	**80 DAT**	**120 DAT**
T_1 (Urea + DAP + MOP) (140:60:60 kg/ha)	6.00	10.00	19.44
T_2 (Urea + DAP + MOP) **(**70:30:30 kg/ha)	6.00	11.00	22.22
T_3 (Urea + DAP + MOP + NPK + Urea) (70:30:30 + 70:30:30)	7.00	12.00	20.00
T_4 (Urea + DAP + MOP + MAP + Urea + MOP) (70:30:30 + 70:30:30)	6.33	13.33	22.22
T_5 (Urea + DAP + MOP + NPK + Urea) (70:30:30 + 55:24:24)	6.67	14.00	25.56
T_6 (Urea + DAP + MOP + MAP + Urea + MOP) (70:30:30 + 55:24:24)	7.00	13.33	25.56
T_7 (Urea + DAP + MOP + NPK + Urea) (70:30:30 + 42:18:18)	7.33	14.33	26.67
T_8 (Urea + DAP + MOP + VAM MAP + Urea + MOP) (70:30:30 + 42:18:18)	10.00	17.00	31.67
T_9 (Urea + DAP + MOP) (137.5:62.5:60)	6.67	13.33	27.22

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T_{10} (Control)	5.67	9.33	18.33
S.Em.±	0.75	1.30	1.81
C.D. at 5 %	2.23	2.10	2.52
C.V %	17.82	16.64	15.10

Polar diameter (cm)

Polar diameter was significant due to application of nutrients and maximum polar diameter (8.33 cm) was recorded in T_8 (Urea + DAP + MOP + MAP + Urea + MOP and 70:30:30 + 42:18:18 kg/ha). The minimum fruit length (5.67 cm) was registered in T_{10} (Control). Refer Table 3.

Equatorial diameter (cm)

Equatorial diameter was significant for the application of nutrients and maximum equatorial diameter (8.33 cm) was noted in T_8 (Urea + DAP + MOP+ MAP + Urea + MOP and 70:30:30 + 55:24:24 kg/ha). The minimum equatorial diameter (5.26 cm) was observed in T_{10} (Control). Refer Table 3.

Fruit weight uniformity within cluster (g)

It is clear from the data that different application of nutrients has non-significant effect on fruit weight uniformity within cluster. Maximum fruit weight uniformity within cluster (596.67 g) was noticed in T10 (control) and minimum fruit weight uniformity within cluster (541.67 g) was recorded in T4 (Urea + DAP + MOP + MAP + Urea + MOP and 70:30:30 + 70:30:30). Refer Table 3.

Table 3: Effect of precision application of nutrients on fruit weight uniformity within cluster, polar diameter and equatorial diameter in tomato (*Solanum lycopersicum* L.)

Treatments	**Fruit weight uniformity within cluster (g)**	**Polar diameter (cm)**	**Equatorial diameter (cm)**
T_1 (Urea + DAP + MOP) (140:60:60 kg/ha)	568.33	7.00	5.70
T_2 (Urea + DAP + MOP) (70:30:30 kg/ha)	565.00	6.67	5.50
T_3 (Urea + DAP + MOP + NPK + Urea) (70:30:30 + 70:30:30)	545.00	7.00	5.56
T_4 (Urea + DAP + MOP + MAP + Urea + MOP) (70:30:30 + 70:30:30)	541.67	7.00	5.50
T_5 (Urea + DAP + MOP + NPK + Urea) (70:30:30 + 55:24:24)	548.33	7.33	5.63
T_6 (Urea + DAP + MOP + MAP + Urea + MOP) (70:30:30 + 55:24:24)	553.33	6.67	6.33
T_7 (Urea + DAP + MOP + NPK + Urea) (70:30:30 + 42:18:18)	563.33	7.00	6.63
T_8 (Urea + DAP + MOP + VAM MAP + Urea + MOP) (70:30:30 + 42:18:18)	566.67	8.33	8.33
T_9 (Urea + DAP + MOP) (137.5:62.5:60)	590.00	6.33	5.33
T_{10} (Control)	596.67	5.67	5.26
S.Em.±	**22.97**	**0.75**	**0.40**
C.D. at 5 %	**NS**	**0.86**	**0.19**
C.V %	**7.06**	**14.00**	**11.61**

Number of fruits plant^{-1}

Results indicated that the application of nutrients on number of fruits per plant was significant. The maximum number of fruit per plant (67.33) was recorded in T_8 (Urea + DAP + MOP + MAP + Urea + MOP and 70:30:30 + 42:18:18 kg/ha) which was at par with T_6 and T_7. Minimum number of fruits plant^{-1} (43.67) was recorded in T_{10} (Control). The data on number of fruits per plant presented in Table 4.3.

Average fruit weight (g)

The data revealed that the application of different nutrients was significant. Significantly, maximum average fruit weight (68.67 g) was recorded in T_9 (Urea + DAP + MOP and 137.5:62.5:60 kg/ha) which was at par with T_7, while the minimum fruit weight (51.33 g) was registered in T_5 (Urea + DAP + MOP + NPK + Urea and 70:30:30 + 55:24:24 kg/ha). The data presented in Table 5.

Yield plant^{-1} (kg)

The experimental finding shows that different application of nutrients exerted significant effect on yield. Furthermore, maximum fruit yield per plant (6.13 kg) was noted in T_8 **(**Urea + DAP + MOP + MAP + Urea + MOP and 70:30:30 + 42:18:18 kg/ha) which was at par with T_7 (Urea + DAP + MOP + NPK + Urea and 70:30:30 + 42:18:18 kg/ha). Whereas, minimum fruit yield plant^{-1} (4.07 kg) was recorded in T_{10} (Control). The data presented in Table 5.

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Total yield (q/ha)

It is evident from the data that total yield is significant due to different application of nutrients, the maximum total yield (344.00 q/ha) was observed in T_8 (Urea + DAP + MOP + VAM MAP + Urea + MOP and 70:30:30 + 42:18:18 kg/ha) which was at par at T_7 and T_9. The minimum total yield (280.00 q/ha) was noticed in T_{10} **(**Urea + DAP + MOP and 140:60:60 kg/ha) which is presented in Table 5.

Table 5. Effect of precision application of nutrients on marketable yield, yield per plant and total yield in tomato (*Solanum lycopersicum* L.)

Treatments	**No. of fruits per plant**	**Average fruit weight (g)**	**Yield/plant (kg)**	**Total yield (q/ha)**
T_1 (Urea + DAP + MOP) (140:60:60 kg/ha)	53.00	56.67	4.97	291.33
T_2 (Urea + DAP + MOP) **(**70:30:30 kg/ha)	53.00	59.33	4.53	283.33
T_3 (Urea + DAP + MOP + NPK + Urea) (70:30:30 + 70:30:30)	45.33	58.67	4.13	306.67
T_4 (Urea + DAP + MOP + MAP + Urea + MOP) (70:30:30 + 70:30:30)	58.67	54.33	4.13	310.00
T_5 (Urea + DAP + MOP + NPK + Urea) (70:30:30 + 55:24:24)	50.00	51.33	4.83	315.00
T_6 (Urea + DAP + MOP + MAP + Urea + MOP) (70:30:30 + 55:24:24)	56.67	62.33	4.33	320.00
T_7 (Urea + DAP + MOP + NPK + Urea) (70:30:30 + 42:18:18)	60.67	67.00	5.57	330.00
T_8 (Urea + DAP + MOP + VAM MAP + Urea + MOP) (70:30:30 + 42:18:18)	67.33	61.00	6.13	344.00
T_9 (Urea + DAP + MOP) (137.5:62.5:60)	59.00	68.67	4.87	343.33
T_{10} (Control)	43.67	60.67	4.07	280.00
S.Em.±	**3.65**	**5.59**	**0.56**	**13.44**
C.D. at 5 %	**10.84**	**4.65**	**1.12**	**20.14**
C.V %	**11.55**	**14.16**	**12.82**	**7.45**

Total soluble solids (%)

The result showed that TSS of tomato tree was significant. Significantly, maximum TSS (4.95 %) was noted in T_7 (Urea + DAP + MOP + NPK + Urea and 70:30:30 + 42:18:18 kg/ha). The minimum TSS (4.34 %) was noted in T_2 **(**Urea + DAP + MOP and 70:30:30 kg/ha).

Dry matter content of fruit (%)

The variation in dry matter content of fruit was observed significant and maximum dry matter content of fruit (6.10 %) was recorded in T_9(Urea + DAP + MOP and 137.5:62.5:60 kg/ha). The minimum dry matter content of fruit (4.23 %) was recorded in T_{10} **(**Control). Table 6.

Table 6: Effect of precision application of nutrients on total soluble solids and dry matter content of tomato fruit (*Solanum lycopersicum* L.)

Treatments	**Total soluble solids (%)**	**Dry matter content of fruit (%)**
T_1 (Urea + DAP + MOP) (140:60:60 kg/ha)	4.50	4.30
T_2 (Urea + DAP + MOP) **(**70:30:30 kg/ha)	4.34	5.10
T_3 (Urea + DAP + MOP + NPK + Urea) (70:30:30 + 70:30:30)	4.45	5.07
T_4 (Urea + DAP + MOP + MAP + Urea + MOP) (70:30:30 + 70:30:30)	4.50	4.98
T_5 (Urea + DAP + MOP + NPK + Urea) (70:30:30 + 55:24:24)	4.58	4.80
T_6 (Urea + DAP + MOP + MAP + Urea + MOP) (70:30:30 + 55:24:24)	4.65	4.97
T_7 (Urea + DAP + MOP + NPK + Urea) (70:30:30 + 42:18:18)	4.95	4.73
T_8 (Urea + DAP + MOP + VAM MAP + Urea + MOP) (70:30:30 + 42:18:18)	4.61	5.02
T_9 (Urea + DAP + MOP) (137.5:62.5:60)	4.72	6.10
T_{10} (Control)	4.50	4.23
S.Em.±	**0.10**	**0.19**

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C.D. at 5 %	**0.30**	**0.57**
C.V %	**3.75**	**6.67**

IV. DISCUSSION

Plant height (cm)

The data revealed that the application of nutrients had produced significant effect on plant height. The maximum plant height (66.67 cm) at 40 was noted in T_7 (Urea + DAP + MOP + NPK + Urea and 70:30:30 + 42:18:18 kg/ha), while maximum plant height (102.33 and 131.00 cm) at 80 and 120 DAT were noted in T_8 (Urea + DAP + MOP + MAP + Urea + MOP and 70:30:30 + 42:18:18 kg/ha). Minimum plant height (55.33, 85.33 and 100.67 cm) at 40, 80 and 120 DAT were noted in T_{10} (Control). The enhancement in the plant height might be due to better uptake and translocation of nitrogen to the growing plants as a result of their availability in the treatment. Similar results were reported by Anburani and Manivannan (2002), Suthar *at el.* (2005) in brinjal, Deka *et al.*, (1996) in chilli and Prativa and Bhattarai (2011) in tomato.

Number of branches plant^{-1}

The effect of different nutrients on number of branches plant^{-1} was noted significant. The data revealed that maximum number of branches plant^{-1} (10.00, 17.00 and 31.67) at 40, 80 and 120 DAT were noted in T_8 (Urea + DAP + MOP + MAP + Urea + MOP and 70:30:30 + 42:18:18 kg/ha), while minimum number of branches plant^{-1} (5.67, 9.33 and 18.33) at 40, 80 and 120 DAT were noted in T_{10} **(**Control). Our result suported by Forton *et al.* (1985); Renuka and Ravishankar (2001), Gosavi *et al*., (2010) and Yeptho *et al.*, (2010) in tomato.

Polar diameter (cm)

The result indicated that polar diameter was significant due to application of nutrients and maximum polar diameter (8.33 cm) was recorded in T_8 (Urea + DAP + MOP + MAP + Urea + MOP and 70:30:30 + 42:18:18 kg/ha). The minimum fruit length (5.67 cm) was registered in T_{10} (Control).

Equatorial diameter (cm)

In case of different application of nutrients, the result was also found significant and maximum equatorial diameter (8.33 cm) was noted in T_8 (Urea + DAP + MOP+ MAP + Urea + MOP and 70:30:30 + 55:24:24 kg/ha). The minimum equatorial diameter (5.26 cm) was observed in T_{10} (Control). The present investigated have reported that integrated nutrient management has significant increase in fruit diameter. The results are in conformation with the findings of Azin *and Dhuma* (2012), Chumyani *et al.*, (2010), Mudasir *et al*., (2009), Ranjit and Bandopadhyay (2014) and Sathyajeet *et al.,* (2014).

Number of fruits plant^{-1}

The data revealed that the application of different nutrients had produced significant effect on number of fruits per plant. The maximum number of fruit per plant (67.33) was recorded in T_8 (Urea + DAP + MOP + MAP + Urea + MOP and 70:30:30 + 42:18:18 kg/ha) which was at par with T_6 and T_7. Minimum number of fruits per plant (43.67) was recorded in T_{10} (Control). Urea, DAP, MOP and MAP combined application boost the fruit yield because application of different nutrients plays an important role in different physiological process as well as enzymatic activity.

These findings are in agreement with Shi *et al*., (2004); Li *et al*., (2009); Shao and Haung (2010) in tomato, Ye *et al*., (2004) in Chinese cabbage and Tang *et al*., (2008) in grapes.

Fruit weight uniformity within cluster (g)

It is clear from the data that different application of nutrients has non-significant effect on fruit weight uniformity within cluster.

Increase in length and size of the fruits may be also due to complementary action of phosphorous and potassium which helps in synthesize the auxins which are responsible for the cell elongation by increasing the cell permeability to water and osmotic solutes of the cells. Besides, auxins are also responsible for inducing the synthesis of specific DNA dependent new m-RNA and specific enzymatic proteins causes increased cell plasticity and extension resulting ultimately in cell enlargement. Besides, increase in the fruit size might be due to the higher uptake of nutrients and more food material synthesis by plant when treated with different nutrients, Mohankumar and Narasegowda (2010). The similar results were confirmative to the findings of Mudasir *et al*. (2009), Prativa and Bhattarai (2011) and Sathyjeet *et al*., (2014).

Average fruit weight (g)

The result indicated that average fruit weight significantly influenced by different application of nutrients. Significantly, maximum average fruit weight (68.67 g) was recorded in T_9 (Urea + DAP + MOP and 137.5:62.5:60 kg/ha) which was at par with T_7 (Urea + DAP + MOP + NPK + Urea and 70:30:30 + 42:18:18), while the minimum fruit weight (51.33 g) was registered in T_5 (Urea + DAP + MOP + NPK + Urea and 70:30:30 + 55:24:24 kg/ha).

Increase in fruit weight may be also due to complementary action of phosphorous and potassium which helps in synthesize the auxins which are responsible for the cell elongation by increasing the cell permeability to water and osmotic solutes of the cells. Furthermore, increase in the fruit weight and size it might be due to the higher uptake of nutrients and more food material synthesis by plant when treated with different nutrients. Mohankumar and Narasegowda (2010). The similar results were confirmative to the findings of Mudasir *et al*. (2009), Prativa and Bhattarai (2011), Ranjit and Bandopadhyay (2014) and Sathyjeet *et al*. (2014).

Yield/plant (kg)

The variation due to different application of nutrients exerted significant effect on yield. Furthermore, maximum fruit yield per plant (6.13 kg) was noted in T_8 **(**Urea + DAP + MOP + MAP + Urea + MOP and 70:30:30 + 42:18:18 kg/ha) which was at par with T_7 (Urea + DAP + MOP + NPK + Urea and 70:30:30 + 42:18:18 kg/ha). Whereas, minimum fruit yield per plant (4.07 kg) was recorded in T_{10} (Control).

Increase in fruit yield may be also due to complementary action of nitrogen, phosphorous and potassium which helps in synthesize the auxins which are responsible for the cell elongation by increasing the cell permeability to water and osmotic solutes of the cells. These findings are in agreement with Ranjit and Bandopadhyay (2014) and Sathyjeet *et al.*, (2014).

Total yield (q/ha)

The effect of nutrients on total yield was significant, the maximum total yield (344.00 q/ha) was observed in T_8 (Urea + DAP + MOP + MAP + Urea + MOP and 70:30:30 + 42:18:18 kg/ha) which was at par at T_7 (Urea + DAP + MOP + NPK + Urea and 70:30:30 + 42:18:18 kg/ha). The minimum total yield (280.00 q/ha) was noticed in T_{10} **(**Control). The enhancement in total yield because of the existence of nitrogen, phosphorus and potassium in different nutrients, these macronutrients are well responsible for the cell elongation. The similar results were found by Mudasir *et al*. (2009), Ranjit and Bandopadhyay (2014).

Total soluble solids (%)

The result showed that TSS of tomato tree was significant. Significantly, maximum TSS (4.95 %) was noted in T_7 (Urea + DAP + MOP + NPK + Urea and 70:30:30 + 42:18:18 kg/ha). The minimum TSS (4.34 %) was noted in T_2 **(**Urea + DAP + MOP and 70:30:30 kg/ha). In this study the enlargement in TSS might be due to exogenic supply of potassium which increased the flow of plant assimilation into the developing fruits especially when assimilate flow from other parts of plant become limited. In addition, supply of potassium also plays a strong role in carbohydrates synthesis, and its breakdown, translocation and synthesis of protein and also neutralizes the physiologically important organic acids. Apart from this, potassium favors the conversion of starch into simple sugars during ripening by activating the sucrose synthetase enzyme thus resulting in higher TSS. The above result corroborates the findings by Singh *et al*. (2014), Gosavi *et al*. (2010) and Kumar *et al*. (2014) were also recorded higher TSS due to soil application of potassium in tomato.

V. SUMMARY AND CONCLUSION

The present investigation entitled “Effect of precision application of nutrients on yield, quality and nutrient use efficiency in tomato (*Solanum lycopersicum* L.) cv. Pearson” was carried out at Bolan Experimental Farm, Department of Horticulture, Helmand University, Helmand during the year 2021. The treatments comprised of **T_1:** Fertilizers **(**Urea + DAP + MOP) (140:60:60 kg/ha), **T_2:** Fertilizers **(**Urea + DAP + MOP) **(**70:30:30 kg/ha), **T3:** Fertilizers + Nutrient Solution (Urea + DAP + MOP + NPK + Urea) (70:30:30 + 70:30:30), **T_4:** Fertilizers + Nutrient Solution (Urea + DAP + MOP + MAP + Urea + MOP) (70:30:30 + 70:30:30), **T_5:** Fertilizers + Nutrient Solution (Urea + DAP + MOP + NPK + Urea) (70:30:30 + 55:24:24), **T_6:** Fertilizers + Nutrient Solution (Urea + DAP + MOP + MAP + Urea + MOP) (70:30:30 + 55:24:24), **T_7:** Fertilizers + Nutrient Solution (Urea + DAP + MOP + NPK + Urea) (70:30:30 + 42:18:18), **T_8:** Fertilizers + Nutrient Solution (Urea + DAP + MOP + MAP + Urea + MOP) (70:30:30 + 42:18:18), **T_9:** RDF (Urea + DAP + MOP) (137.5:62.5:60) and **T_{10}:** Control (No fertilizer). It was concluded that all treatments ranked regarding their effects as (T_8> T_9> T_7> T_6> T_5> T_4> T_3> T_2> T_1> $T_{Control}$) for all attributes such as plant height, branches plant^{-1}, fruits plant^{-1}, polar diameter, equatorial diameter, fruit weight uniformity within cluster^{-1}, average fruit weight, fruit yield plant^{-1}and total yield (kg ha^{-1}).

VI. CONCLUSION

- On the basis of results obtained from the present investigation, it was concluded that application of Urea + DAP + MOP (129.5+65.2+50.0 kg/ha) and nutrient solution MAP + Urea + MOP (29.5+83.5+30.0 kg/ha) showed better performance for getting higher yield and quality of tomato. (344.00q/ha) was noticed in T_8 and minimum yield (283.33q/ha) was recorded in T_2 Urea + DAP + MOP (129.5+65.2+50.0 kg/ha).
- It is evident from the data that the minimum total yield (280.00 q/ha) was noticed in T_{10} (control).

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