Effect of Varying Levels of Nitrogen on the Growth and Yield of Muskmelon (*Cucumis melo* L.)

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Abstract: Nitrogen (N) fertilization at higher rates enhances the yield of crop plants; however, overuse of N in cultivation of crop not only decreased Nitrogen Use Efficiency of crop plants but caused severe environmental pollution. Hence, the optimum use of N is perquisite for sustainable development of Agriculture. This study was carried out during 2016, to evaluate the effect of various nitrogen applications on the economic performance of muskmelon. This research work was laid out at experimental site of Horticulture orchard SAU Tandojam with three replications in RCBD. The growth and yield performance of muskmelon was assessed by using six nitrogen (N) levels viz; 0, 30, 60, 90, 120 and 150 kg ha^{-1}. Two varieties including Chandny and golden tumbro were used in the current study.The result showed that effect of different nitrogen doses on the economic important parameters of muskmelon was significant ($P<0.05$) for all the studied traits. The crop fertilized with maximum N had positive effect on vegetative traits and produced tallest plants with more branches. Nitrogen also showed significant effects on fruits characteristics and produced plants with more fruits, highest weight and maximum yield. The results further reflected that there was a significant reduction in all vegetative and fruit contributing characters with each reduction in N application rate. The cultivars revealed a highly significant response to various N doses. The variety Golden Tumbro showed maximum vine length (201.00 cm), more branches $vine^{-1}$ (3.4222), more fruit $vine^{-1}$ (6.7339), highest fruits weight $vine^{-1}$ (3.0056), maximum single fruit weight (656.83 g), fruit yield $plot^{-1}$ (4.4450 kg) and fruit yield (24.635 t ha^{-1}).

Keywords: Muskmelon, Nitrogen, Fertilizer, Fruit, Vine.

INTRODUCTION

Muskmelon (*Cucumis melo* L.) is one of the delicious fruits planted on 1.3 million hectare of area with overall annual production of 26.8 million tones [1]. Muskmelons (*Cucumis melo* L.) are generally grown in both tropical and warm temperate climates globally. It is commercially grown in many countries of the world. China has the largest share in total area and production of muskmelon and contributes world half production [2]. The yield of muskmelon is determined by accumulation of biomass of fruit and distribution of dry matter [3]. Large quantity of assimilates and fast growth of leaf biomass is essential during development and growth to obtain high yield and good quality of fruits. Application of synthetic fertilizers is very important in enhancing the yield of cultivated crops and their optimum and timely application significantly improve quantity, yield and quality of fruits [4]. However, it is advisable that before application of any nutrient, soil testing of experimental area is unavoidable. Among various nutrients applied to crop plants, N occupies a significant position. For better productivity, growth and longevity nitrogen is a dominant to achieve desirable yield [5]. Deficiency of nutrients showed adverse affects on productivity of melon in dry climates [6]. Uptake of nitrogen in muskmelon is still not understood and the diverse cultivars of melon are different in relation to growth and yield therefore, farmers applied huge quantity of nitrogen fertilizer in muskmelon which reveals adverse reaction in soil and plant productivity [7]. In case of primary nutrients, nitrogen is one of the most crucial elements for growth and development as well as play important function for cell division, cell elongation and chlorophyll synthesis [8]. Nitrogen also contain co-enzymes which are helpful in physiological processes like photosynthesis, cell division, nutrients metabolism, growth of root and shoot expansion as well vegetative growth [9].

MATERIALS AND METHODS

The present research work was laid out with a goal to assess the impact of various nitrogen applications on the growth, development and yield of muskmelon. The

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experiment was done during 2016 at Horticulture garden SAU Tandojam. The crop was sown in a three repeated rows with randomized complete block design (RCBD). The size of plot was 5 m x 3 m (15 m^2). Growth and yield performance of two muskmelon varieties (Chandny and Golden Tumbro) was assessed under six different N levels. The data were statistically analyzed using Statistics- 8.1 computer software [10].

RESULTS AND DISCUSSION

Vine Length (cm)

The results showed that length of vine is highly fluctuated by various applications of N as well as cultivated varieties. The results further demonstrated that highest nitrogen level of 150 kg ha^{-1} produced maximum length of vine 225.88 cm, followed by nitrogen levels 120 kg ha^{-1} and90 kg ha^{-1} producing average vine length of 215.00 and 202.83 cm, respectively (Table **1**). The vine length further reduced to 194.33 and 178.50 cm when nitrogen levels were reduced to 60 kg ha^{-1} and 30 kg ha^{-1}. The lowest vine length of 142.50 cm was noted in (Control). In case of muskmelon varieties the vine length was greater (201.00 cm) in variety Golden Tumbro as compared to Chandnyas given in (Table **1**). The treatment interaction of nitrogen levels and muskmelon varieties shows maximum vine length (234.00 cm) for the interaction of N @ 150 kg ha^{-1} x Golden Tumbro; while the lowest vine length of (136.67 cm) was recorded in control (untreated) x Chandny interaction.

In current study, the vine length in muskmelon increased with increasing the rate of nitrogen application. These results clearly reflect the leading role of N for optimum plant growth and development, the trait vine length could not flourish economically and lower values were recorded. Moreover, this also indicates the deficiency of N in the soil. The vine length was markedly higher when N application was done at the highest rate 150 kg ha^{-1}. These results are related to [11] who also found maximum vine length under increasing N levels.

Number of Branches $Vine^{-1}$

Both the genotypes and various N applications showed highly significant differences ($P<0.05$) for branches $vine^{-1}$. The results demonstrated that highest nitrogen level of 150 kg ha^{-1} revealed greatest number of branches $vine^{-1}$ (4.6667) followed by nitrogen levels 120 kg ha^{-1} and 90 kg ha^{-1}that showed number of branches $vine^{-1}$ of 3.6500 and 3.1000, individually (Table **2**). The quantity of branches $vine^{-1}$ further lessened to 2.8833 and 2.4667 when nitrogen levels were decreased to 60 kg ha^{-1} and 30 kg ha^{-1}, separately. The minimum branches $vine^{-1}$ of 2.2167 cm were noted in untreated plant where nitrogen application was suspended as shown in (Table **2**). While in muskmelon cultivars, the branches vine-^{1} were higher (3.4222) in cultivar Golden Tumbro in comparison with Chandny (Table **2**). The interaction of N @ 150 kg ha^{-1} x Golden Tumbro showed maximum branches $vine^{-1}$ (5.5000) while the least number of branches vine-1 (2.1333) were noted in (untreated) x Chandny interaction. Number of branches $vine^{-1}$ in muskmelon is an important character that highly affects the final yield. In the present investigation, the branches$vine^{-1}$in muskmelon increased with increasing the rate of nitrogen. The crop response to nitrogen levels for its branching capacity clearly indicates the soil nitrogen deficiency and the branches $vine^{-1}$ were clearly higher when N was applied at the rate of 150 kg ha^{-1}. Same result was given by [12] who observed that whenever the rate of nitrogen level is increasing it response positively for the setting of branches in

Table 1: Vine Length (cm) of Muskmelon as Affected by Nitrogen Levels and Varieties

Nitrogen levels (N)	Varieties (V)		Mean
	V1= Chandny	V2 = Golden Tumbro	
N1 = control (untreated)	136.67	148.33	142.50 F
N2 = 30 kg ha^{-1}	173.33	183.67	178.50 E
N3 = 60 kg ha^{-1}	186.67	202.00	194.33 D
N4 = 90 kg ha^{-1}	191.67	214.00	202.83 C
N5 = 120 kg ha^{-1}	206.00	224.00	215.00 B
N6 = 150 kg ha^{-1}	217.67	234.00	225.83 A
Mean	185.33 B	201.00 A	

Table 2: Number of Branches Vine^{-1} of Muskmelon as Affected by Nitrogen Levels and Varieties

Nitrogen levels (N)	Varieties (V)		Mean
	V1= Chandny	V2 = Golden Tumbro	
N1 = control (untreated)	2.1333	2.3000	2.2167 D
N2 = 30 kg ha^{-1}	2.5000	2.4333	2.4667 D
N3 = 60 kg ha^{-1}	2.8000	2.9667	2.8833 C
N4 = 90 kg ha^{-1}	3.1000	3.1000	3.1000 C
N5 = 120 kg ha^{-1}	3.0667	4.2333	3.6500 B
N6 = 150 kg ha^{-1}	3.8333	5.5000	4.6667 A
Mean	2.9056 B	3.4222 A	

muskmelon [13]. Also reported the positive effect of N fertilizers for better growth and productivity of okra.

Fruit Vine^{-1}

The results related to fruits vine^{-1} as influenced by various nitrogen levels and cultivars are given in Table **3**. Both N levels and their interaction with varieties demonstrated highly significant difference ($P<0.05$). The findings demonstrated that upper nitrogen application of 150 kg ha^{-1} produced more fruits vine^{-1} (7.6267), second 120 kg ha^{-1} and 90 kg ha^{-1} sett fruits 7.3783 and 7.0117. The fruits vine^{-1} further reduced to 6.1750 and 5.4100, respectively, when nitrogen application rates were reduced to 60 kg ha^{-1} and 30 kg ha^{-1}, respectively. The minimum fruits vine^{-1} of 3.9033 was observed in (untreated) plant where nitrogen was not added in the soil. Both the cultivars showed highly contrasted response to various N levels. The maximum number of fruits vine^{-1} (6.7339) was observed in Golden Tumbro. The interactions of N doses and cultivars revealed greatest fruits vine^{-1} (8.2533) in interaction of N @ 150 kg ha^{-1} x Golden Tumbro; while the least fruits vine^{-1} of (3.0500) was recorded in control (untreated) x Chandny interaction. Fruits vine^{-1} (g) in muskmelon is an essential trait that highly affects the total crop productivity. In the present research work's result is further supported by [14] who reported that N application in larger quantity produced maximum fruit vien^{-1} in cucumber. Similar results have been obtained by [15] who reported that optimum application of N showed maximum fruits in okra.

Single Fruit Weight (g)

The results related to weight of single fruit as affected by different nitrogen levels and varieties are given in Table **5**. The results depicted that maximum nitrogen dose of 150 kg ha^{-1} resulted greatest individual fruit weight 890.00 g, followed by nitrogen levels 120 kg ha^{-1} and 90 kg ha^{-1} showing individual fruit weight of 787.67 g and 685.67 g, respectively. The single fruit weight further diminished to 579.67 g and 446.33 g when nitrogen doses were reduced to 60 kg ha^{-1} and 30 kg ha^{-1}, respectively. The minimum individual weight of 367.00 g was recorded in (untreated). In varieties, the individual fruit weight was higher (656.83 g) in Golden Tumbro in comparison with Chandny as given in (Table **4**). The interaction results demonstrates that N @ 150 kg ha^{-1} x Golden Tumbro showed highest single fruit weight (930.00 g), while the interaction of control (untreated) x Chandny showed

Table 3: Fruits Vine^{-1} of Muskmelon as Affected by Nitrogen Levels and Varieties

Nitrogen levels (N)	Varieties (V)		Mean
	V1= Chandny	V2 = Golden Tumbro	
N1 = control (untreated)	3.0500	4.7567	3.9033 F
N2 = 30 kg ha^{-1}	5.1333	5.6867	5.4100 E
N3 = 60 kg ha^{-1}	6.1300	6.2200	6.1750 D
N4 = 90 kg ha^{-1}	6.4000	7.6233	7.0117 C
N5 = 120 kg ha^{-1}	6.8933	7.8633	7.3783 B
N6 = 150 kg ha^{-1}	7.0000	8.2533	7.6267 A
Mean	5.7678 B	6.7339 A	

Table 4: Weight of Single Fruit (g) of Muskmelon as Affected by Nitrogen Levels and Varieties

Nitrogen levels (N)	Varieties (V)		Mean
	V1= Chandny	V2 = Golden Tumbro	
N1 = control (untreated)	361.67	372.33	367.00 D
N2 = 30 kg ha^{-1}	406.67	486.00	446.33 E
N3 = 60 kg ha^{-1}	570.33	589.00	579.67 D
N4 = 90 kg ha^{-1}	654.00	717.33	685.67 C
N5 = 120 kg ha^{-1}	729.00	846.33	787.67 B
N6 = 150 kg ha^{-1}	850.00	930.00	890.00 A
Mean	595.28 B	656.83 A	

minimum fruit weight (361.67 g).These results clearly indicated that experimental soil was lacking in nitrogen. The application of N at higher quantity positively affected the fertility of soil, resultantly heavier fruits were obtained. The research work related to effect of N on fruits of muskmelon is not documented. However, available reports related to other cucurbits crops including cucumber and bottle gourd revealed the positive role of N in enhancing the single fruit weight [14, 16, 17]. These results are also in accordance with the result of [18] who reported that 150 kg ha^{-1} N produced maximum fruit weight in okra. Similarly, [19] reported that N application was associated with the maximum single fruit weight in okra.

Weight of Fruits Vine^{-1} (kg)

The results related to fruits vine^{-1}was also affected by the application of various nitrogen doses and muskmelon varieties which are highlighted bellow in tabulated form. The findings confirmed that highest nitrogen dose of 150 kg ha^{-1} showed greatest weight of fruits vine^{-1} (3.7500 kg), than 120 kg ha^{-1} and 90 kg ha^{-1} that produced fruits vine^{-1} of 3.7333 kg and 3.1167 kg, respectively. The fruits weight vine^{-1} further decreased to 2.6667 kg and 2.0333 kg when nitrogen levels were reduced to 60 kg ha^{-1} and 30 kg ha^{-1}, respectively. The cultivars revealed a highly significant response to various N doses and cultivars and N doses interactions. The highest fruit weight vine^{-1} (3.0056 kg) was recorded in Golden Tumbro as compared to Chandny (Table **5**). The interaction indicates that maximum fruits vine^{-1} (4.2333 kg) was obtained with the interaction of N @ 120 kg ha^{-1} x Golden Tumbro; while the lowest weight of fruits vine^{-1} of 1.2333 kg was recorded in (untreated x Chandny) interaction. So far a very limited work has been performed on effect of N on weight of fruits of muskmelon. However other studies related to okra clearly showed the positive role of N for better fruit growth and development [20]. Suggested 150 kg ha^{-1} of N for maximum fruit weight in okra, while

Fruit Yield Plot^{-1} (kg)

The results about yield of fruit were affected by different N levels and varieties which are given bellow. This revealed upper application of treatment 150 kg ha^{-1} formed greater fruit yield plot^{-1}5.9883 kg, followed by nitrogen levels 120 kg ha^{-1} and90 kg ha^{-1} producing average fruit yield plot^{-1} of 5.3050 kg and 4.7583 kg, respectively. The fruit yield plot^{-1} further reduced to 4.2600 kg and 3.7250 kg when nitrogen levels were

Table 5: Weight of Fruits Vine^{-1} (kg) of Muskmelon as Affected by Nitrogen Levels and Varieties

Nitrogen levels (N)	Varieties (V)		Mean
	V1= Chandny	V2 = Golden Tumbro	
N1 = control (untreated)	1.2333	1.2667	1.2500 E
N2 = 30 kg ha^{-1}	2.0333	2.0333	2.0333 D
N3 = 60 kg ha^{-1}	2.4333	2.9000	2.6667 C
N4 = 90 kg ha^{-1}	2.8000	3.4333	3.1167 B
N5 = 120 kg ha^{-1}	3.3333	4.1667	3.7500 A
N6 = 150 kg ha^{-1}	3.2333	4.2333	3.7333 A
Mean	2.5111 B	3.0056 A	

Table 6: Yield of Fruits Plot^{-1} (kg) of Muskmelon as Affected by Nitrogen Applications and Varieties

Nitrogen levels (N)	Varieties (V)		Mean
	V1= Chandny	V2 = Golden Tumbro	
N1 = control (untreated)	1.0800	1.2200	1.1500 F
N2 = 30 kg ha^{-1}	3.4800	3.9700	3.7250 E
N3 = 60 kg ha^{-1}	3.9300	4.5900	4.2600 D
N4 = 90 kg ha^{-1}	4.4867	5.0300	4.7583 C
N5 = 120 kg ha^{-1}	4.9800	5.6300	5.3050 B
N6 = 150 kg ha^{-1}	5.7467	6.2300	5.9883 A
Mean	3.9506 B	4.4450 A	

Table 7: Fruit Yield (t ha^{-1}) of Muskmelon as Affected by Nitrogen Levels and Varieties

Nitrogen levels (N)	Varieties (V)		Mean
	V1= Chandny	V2 = Golden Tumbro	
N1 = control (untreated)	7.217	8.108	7.662 F
N2 = 30 kg ha^{-1}	14.215	16.480	15.348 E
N3 = 60 kg ha^{-1}	20.214	25.626	22.920 D
N4 = 90 kg ha^{-1}	24.583	27.175	25.879 C
N5 = 120 kg ha^{-1}	28.549	32.879	30.714 B
N6 = 150 kg ha^{-1}	33.628	37.541	35.585 A
Mean	21.401 B	24.635 A	

reduced to 60 kg ha^{-1} and 30 kg ha^{-1}, while shortest number of fruit yield plot^{-1} of 1.1500 kg was recorded in (untreated) plant (Table **6**). In case of muskmelon varieties the fruit yield plot^{-1} was higher (4.4450 kg) in variety Golden Tumbro as compared to Chandny. The interactive effects of nitrogen levels and muskmelon varieties shows maximum fruit yield plot^{-1} (6.2300 kg) for N @ 150 kg ha^{-1} x Golden Tumbro; while the lowest fruit yield plot^{-1} of (1.0800 kg) was recorded in control (untreated) x Chandny interaction. The studies related to effect of N on fruit yield plot^{-1} of muskmelon is limited. However, several other studies associated with okra have showed highly positive effect of N on fruit yield [19] suggested 100 kg ha^{-1} for maximum fruit yield plot^{-1} in the same crop.

Fruit Yield (t ha^{-1})

The results reflected that N at amount of 150 kg ha^{-1} gave higher fruit yield of 35.585 t ha^{-1}; second 120 and 90 kg N ha^{-1} with 30.714 and 25.879 t ha^{-1}, respectively; while lowest fruit yield of 7.662 t ha^{-1} was observed in untreated plots as given in (Table **7**). In case of varieties maximum fruit yield (24.635 t ha^{-1}) was obtained in Golden Tumbro. Limited studies have been performed on influence of N on fruit yield of muskmelon. However available reports related to other cucurbit crops including cucumber and bottle gourd demonstrated the significant role of N in improving the fruit yield.

CONCLUSION

It was concluded that nitrogen application of about 150 kg ha^{-1} proved to be best level for achieving economically higher yield of fruits in muskmelon. Among varieties, Golden Tumbro showed significantly better performance than Chandny. However, further research needs to be performed in different location and wide variety of soils for confirming and validating the results of the current study.

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