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Effect of graded levels of nitrogen and potassium on yield and nutrient content of watermelon in lateritic soils of Konkan

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Abstract
A field experiment was conducted to study the effect of graded levels of nitrogen and potassium on yield and nutrient content of watermelon grown in lateritic soils of Konkan region. The result were revealed that application of nitrogen with rational appliance of potassium doses significantly increases the average weight of fruits, number of fruits per plot and ultimately the yield of watermelon and crop was confirms highly responsiveness to it. The nutrient content of plant also illustrates the positive response on various characters. The best results were obtained at treatment T_{10} application of N: P_2O_5: K @ 150: 50: 100 kg ha^{-1} gave the maximum yield and was thus optimum fertilizer dose for lateritic soils of Konkan region of Maharashtra

Keywords: Watermelon, yield, nutrient content, Konkan

1. Introduction
Watermelon [*Citrullus lanatus* (Thunb.)] is an important fruit crop among the various cucurbits grown in Maharashtra, for its sweet juicy fruits for quenching the thirst especially during summer season. Even though, tropical Africa is considered to be the place of origin of watermelon, in India it is in cultivation since thousands of years hence India is often considered as secondary place of origin (Fursa, 1973) [3].
The commercial cultivation of watermelon is possible in rice based cropping system in Konkan region. It is grown immediately after harvesting of paddy. Thus, it has been occupying prominent position in rice based cropping system in most of the part of Konkan region. It is generally grown during month of October to March after harvesting of paddy. Due to mild winter, it is grown as early crop in the Konkan region, which results in early harvest of fruits and fetches better price in market. In North Konkan region, watermelon has tremendous potential for cultivation in rice based cropping system due to nearness of metropolitan market like Mumbai and Thane. The present paper includes the results of studies on the effect of N and K on the fruits of var. Augasta watermelon.

2. Materials and Methods
A field experiment on "Effect of graded levels of nitrogen and potassium on yield and nutrient content of watermelon in lateritic soils of Konkan" was conducted with application of N at the rate of 100, 150 and 200 kg ha^{-1} and K at 50, 75 and 100 kg ha^{-1} combined with constant application of P at the rate of 50 kg ha^{-1}tried in Randomized Block Design comprising eleven treatments replicated thrice at Department of Agronomy, College of Agriculture Dapoli, Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli, Dist. - Ratnagiri during *Rabi* 2014-2015. The effect of application of graded levels of N and K were studied at 30 DAS, 60 DAS and at harvest with MOP and SOP as a source of potassium on growth, yield and nutrient content in plant.

3. Results and Discussion
The yield attributing characters *viz.* average weight of fruit, number of fruit per plot and total yield of fruits indicated that these parameters were significantly affected due to application of different levels of nitrogen and potassium.

3.1 Average weight of fruits (kg.)
The weight of fruit is one of the most important yields attributing character of watermelon crop.

It is evident that the treatment T_{10} receiving 150:50:100N: P: K kg ha^{-1} showed higher weight of fruit 3.64 kg which was significantly higher as compared to the control (1.94 kg). From the Table 1, it is seen that the average weight of fruit increased with application of nitrogen with unprejudiced amplified appliance of potassium doses. The treatment T_{10} showed significantly higher over control and remained at par with the treatments T_4, T_5, T_6, T_7, T_8, T_9 and T_{11}.

Similar results were reported by Sawaratkar (2014) [10] for the *var*. Augasta *i.e*. 3.72 kg. Okur and Yagmur (2004) [8] showed parallel results in watermelon that highest fruit weight (4.63 kg) was obtained by application of 120:80:240 kg N: P_2O_5: K_2O ha^{-1} along with micronutrients. Kolekar *et al.* (2013) [7] reported average weight of fruit (3.27 kg) in watermelon which was obtained by treatment drip irrigation, 125% RDF and 125% manure.

3.2 Number of fruits per plot

The significant differences in number of fruits per plot with response to the application of graded levels of nitrogen and potassium to the watermelon crop were observed. The treatment T_1 (control) showed lowest number of fruits 12.33. As contrast, T_{10} receiving 150:50:100 N: P: K: kg ha^{-1} was extensively better with 16.33 fruits per plot taken as a whole and found to be at par with the treatments T_2, T_3, T_8 and T_{11} with 16, 15, 14.67 and 14.67, respectively. From the foregoing results and discussion on the number of fruits per plot of watermelon, it was concluded that the application of combined doses of nitrogen and potassium exhibited favorable results on number on fruits per plot. Similar findings were also reported by Inamdar (2009) [5] in watermelon.

3.3 Yield of fruit (t ha^{-1})

The results comprehend that fruit yield was significantly affected due to different levels of nitrogen and potassium. The significantly higher yield was recorded by the treatment T_{10} receiving 150:50:100 N: P_2O_5: K_2O kg ha^{-1}, treatment T_{10} which was at par with the treatment T_9 (100:50:100 N: P_2O_5: K_2Okg ha^{-1}) and treatment T_{11} (200:50:100 N: P_2O_5: K_2Okg ha^{-1}) getting yield 37.020 and 36.906 tones ha^{-1}, respectively. The treatment T_2 receiving 100:50:50 N: P_2O_5: K_2O kg ha^{-1} with source of potassium through the muriate of potash (KCl) showed 29.650 tones ha^{-1} yield which was superior than the treatment T_1 (control) *i.e.*19.775 tones ha^{-1} but, treatment T_3 receiving same dose (100:50:50 NPK kg ha^{-1}) using the sulfate of potash (SOP) as source of potassium showed numerically higher yield *i.e.* 31.195 tones ha^{-1} over treatment T_2.

A perusal of the data given in Table 1 showed that the yield of watermelon increased with the application of nitrogen along with evenhanded application of potassium using sulfate of potash as a source of K_2O as compared to muriate of potash. Besides that, the treatment T_{11} (200:50:100N:P_2O_5:K_2O kg ha^{-1}) showed the yield of 36.906 t ha^{-1} which was lower than treatment T_{10} (150:50:100N:P_2O_5:K_2O kg ha^{-1}) having 40.570 t ha^{-1} yield. It was revealed that the excess application of nitrogen can suppress the yield of watermelon.

Similar results were reported by Vasanthkumar *et al.* (2012) [12] in genotype NS-246 and NS-295 which recorded 38.60 and 36.01 t ha^{-1} fruit yield in watermelon, respectively. Okur and Yagmur (2004) [8] reported that yield of watermelon was increased with the potassium dose increasing.

3.4 Nutrient content

The periodical plant samples collected as 30, 60 days after sowing and at harvest were analyzed for N, P, K, content. The data were statistically processed and interpreted here under nutrient content.

3.5 Nitrogen content (%)

The data pertaining to the nitrogen content at 30 DAS in watermelon plant as affected by application of different levels of nitrogen and potassium. Significantly higher nitrogen content (2.05%) was recorded in the treatment T_{11} (200:50:100 kg ha^{-1}) remained at par to the all other treatments except T_1 (control) and T_2 [100:50:50 kg ha^{-1} NPK (MOP)] with 1.38 and 1.55 per cent nitrogen. It was observed that the N content increased with increase in the dose of nitrogen. Hegde (1989) [4] reported that an increasing application of N increased the concentration of N.

At 60 days after sowing, significant variation was observed in N content in watermelon leaves and it was ranged from 1.07 to 1.99 per cent. Highest N content was recorded in the treatment T_{10} (1.99%) which was at par with treatments T_6, T_7, T_8 and T_{11}.

At harvest, N content in leaves of watermelon ranged between 0.55 and 1.11 per cent, T_{11} was significantly higher with all treatments and remained at par with treatment T_5, T_8 and T_{10}.In general, it was observed that total nitrogen content in leaves was increased at 30 DAS; later on it was declined at 60 DAS and harvest stage. This might be due to the use of N content by plant for flowering and fruiting of watermelon.

Reuter and Robinson (1986) [9] studied the limit values of nutrients in watermelon leaves and reported that limit value for nitrogen was 2.5-4.5%. Similar study was conducted Sevimli (1996) [11] and found that the limit value for nitrogen was 2.0-3.0 per cent and 3.90-5.54 per cent.

Similar pattern nitrogen content in watermelon was reported by Kadu (2015) [6] and values were supported to the findings in lateritic soils of Konkan.

3.6 Phosphorus content (%)

Application of different levels of nitrogen and potassium would significantly affect the concentration P in the watermelon leaves. The phosphorus content in ranged from 0.14 to 0.19 per cent, 0.07 to 0.10 per cent and 0.065 to 0.080 per cent at 30 DAS, 60 DAS and at harvest of the watermelon. At 30 DAS significantly higher content of P was exhibited by the treatment T_5 (200:50:50 kg N, P_2O_5, K_2O ha^{-1}) over T_1, T_6 and T_9 and remained at par with T_2, T_3, T_4, T_7, T_8, T_{10} and T_{11}.Similarly, at 60 DAS the same treatment *i.e.* T_5 recorded higher P content over T_1, T_2, T_3 and remained at par with rest of all the treatments. At harvest the treatment T_{11} where in the N P K was applied @ 200:50:100 kg ha^{-1} showed significantly higher P content (0.080%) over all the treatments except T_5 and T_6 which remained at par with T_{11} (Table2).

In general, it was observed that the total phosphorus content in leaves higher at 30 DAS; later on it declined at 60 DAS and harvest stage. This might be due to uptake of native phosphorus translocated for metabolic activities. The phosphorus content in watermelon leaves varied from 0.13 to 0.27 per cent (Kadu 2015) [6].

Similar results were reported by Cikili *et al.* (2013) [2] in cucumber plant in which shoot P accumulation ranged from 0.11 to 0.31 per cent in both K and B treatments. Okur and Yagmur (2004) [8] reported that leaf phosphorus content lies between 0.13 to 0.18 per cent in watermelon crops by the treatment of different levels of potassium.

3.7 Potassium content (%)

It is revealed that, the treatment T_{11} receiving 200:50:100 NPK kg ha^{-1} showed highest potassium content (2.67%) in leaves of watermelon taken as a whole however, it remained at par with the treatments T_4 (2.36%), T_5 (2.41%), T_7 (2.38%), T_8 (2.43%), T_9 (2.53%) and T_{10} (2.64%). The drifts in data indicated that the higher application of potassium increases its concentration in the leaves of watermelon at 30 DAS.

At 60 DAS significant transformation in the potassium content was observed (Table 15). The significantly highest potassium content was recorded by the treatment T_{11} (0.99%) over all the treatments except treatment T_{10} (0.90%) which was remained at par with T_{11}.

It is observed that was the increase in the concentration of potassium in watermelon leaves at harvest which ranged between 0.78 and 1.85 per cent. The significant change was experienced at harvest where the treatment T_{11} (1.85%) receiving 200:50:100 kg ha^{-1} NPK exhibited significantly higher K content over T_1 (0.78) control and T_2 (0.86) receiving 100:50: 50 kg ha^{-1} NPK (MOP) and remained at par with rest of all the treatments. The increase in potassium content might be due to effect of application of second split dose of potassium after 60 days.

In general, it was observed that total potassium content in leaves increased at 30 DAS; later on it declined at 60 DAS and harvest stage. This might be due to uptake of potassium by the crop for metabolic activities. Similar results were also shown by Cikili *et al*. (2013) [2] in cucumber crop and reported that increased potassium content in leaves as increasing the application rate of potassium and boron. Anonymous (1994) [1] resulted that leaf potassium concentration was increased by all K fertilization treatment in watermelon crop. Okur and Yagmur (2004) [8] reported that leaf potassium content increased as increasing the application rate of potassium in watermelon crop.

Table 1: Effect of different levels of nitrogen and potassium on yield and yield contributing characters of watermelon

Tr. No.	Treatment	Average wt. of fruits (kg)	Number of fruits per plot	Yield of Fruit (t ha^{-1})
T_1	Control (No NPK)	1.94	12.33	19.77
T_2	100:50:50 N:P_2O_5:K_2O(MOP) kg ha^{-1}	2.24	16.00	29.65
T_3	100:50:50 N:P_2O_5:K_2O(SOP) kg ha^{-1}	2.43	15.00	31.19
T_4	150:50:50 N:P_2O_5:K_2O kg ha^{-1}	3.43	11.67	32.79
T_5	200:50:50 N:P_2O_5:K_2O kg ha^{-1}	3.30	13.33	33.39
T_6	100:50:75N:P_2O_5:K_2O kg ha^{-1}	3.36	11.33	31.89
T_7	150:50:75N:P_2O_5:K_2O kg ha^{-1}	2.93	14.00	34.31
T_8	200:50:75N:P_2O_5:K_2O kg ha^{-1}	2.98	14.67	34.99
T_9	100:50:100N:P_2O_5:K_2O kg ha^{-1}	3.22	12.33	37.02
T_{10}	150:50:100N:P_2O_5:K_2O kg ha^{-1}	3.64	16.33	40.57
T_{11}	200:50:100N:P_2O_5:K_2O kg ha^{-1}	3.18	14.67	36.91
S.E.±		0.33	0.59	1.36
C.D. (P=0.05)		0.98	1.75	4.00

Table 2: Effect of different levels of nitrogen and potassium on total nitrogen, total phosphorus and total potassium content in plant at different growth stages of watermelon

Tr. No.	Treatments	Nitrogen content (%)			Phosphorus content (%)			Potassium content (%)		
		30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest
T_1	Control (No NPK)	1.38	1.07	0.55	0.141	0.070	0.065	2.09	0.39	0.78
T_2	100:50:50 N:P_2O_5:K_2O(MOP) kg ha^{-1}	1.55	1.32	0.88	0.174	0.074	0.070	2.31	0.59	0.86
T_3	100:50:50 N:P_2O_5:K_2O(SOP) kg ha^{-1}	1.79	1.46	0.75	0.179	0.083	0.070	2.30	0.73	1.27
T_4	150:50:50 N:P_2O_5:K_2O kg ha^{-1}	1.82	1.57	0.86	0.193	0.090	0.072	2.36	0.76	1.44
T_5	200:50:50 N:P_2O_5:K_2O kg ha^{-1}	1.95	1.42	0.97	0.197	0.102	0.076	2.41	0.80	1.51
T_6	100:50:75N:P_2O_5:K_2O kg ha^{-1}	1.76	1.95	0.78	0.161	0.088	0.069	2.34	0.78	1.53
T_7	150:50:75N:P_2O_5:K_2O kg ha^{-1}	1.86	1.78	0.87	0.180	0.091	0.072	2.38	0.80	1.60
T_8	200:50:75N:P_2O_5:K_2O kg ha^{-1}	1.95	1.86	1.04	0.190	0.096	0.076	2.45	0.83	1.74
T_9	100:50:100N:P_2O_5:K_2O kg ha^{-1}	1.81	1.63	0.74	0.165	0.089	0.070	2.53	0.88	1.76
T_{10}	150:50:100N:P_2O_5:K_2O kg ha^{-1}	1.89	1.99	0.94	0.195	0.095	0.072	2.64	0.90	1.79
T_{11}	200:50:100N:P_2O_5:K_2O kg ha^{-1}	2.05	1.34	1.11	0.191	0.098	0.080	2.67	0.99	1.85
S.E.±		0.10	0.109	0.059	0.01	0.006	0.002	0.11	0.036	0.226
C.D. (P=0.05)		0.31	0.322	0.175	0.03	0.018	0.007	0.32	0.106	0.668

4. Conclusion

Considering yield contributing characters the application of N:P_2O_5:K_2O @ 150:50:100 kg ha^{-1} i.e. treatment T_{10} was found statistically superior over all the treatments even with application 50 kg N lesser as compared to treatment T_{11}.The nutrient content in leaves at various stages was also influenced due to various treatments. Application of N: P_2O_5: K_2O @ 200:50:100 kg ha^{-1} i.e. treatment T_{11} was recorded the higher nutrient concentration however remained at par with treatment T_{10}

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