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THE EFFECT OF DIFFERENT RATE SEQUENTIAL APPLICATION OF NIROGEN ON CAPSICUM (*Capsicum annum L*) YIELD

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ABSTRACT

Capsicum (Capsicum annum L) is a vegetable of solanaceae family and demands a higher amounts of nutrients for good harvest. A field experiment was conducted to investigate effect of different quantity of basal nitrogen (N) and different sequential application of nitrogen on the yield of capsicum. Randomized Complete Block Design was used with three replicates. Treatments used were T_1 (0 kg N/ha), T_2 (40 kg N/ha as basal + 4 splits of 30 kg N/ha), T_3 (80 kg N/ha as basal + 4 splits of 20 kg N/ha), T_4 (120 kg N/ha as basal + 4 splits of 10 kg N/ha), T_5 (160 kg N/ha as basal + no top dress), T_6 (45 kg N/ha as basal + 2 splits of 45 kg N/ha). All other cultural practices were maintained and Neem kernel extract was applied as every week for manage the pest incidence. This study showed that a significant difference in capsicum yield among the different treatments. T_3 (80 kg N/ha as basal and 4 splits of 20 kg N/ha of N) treatment given the highest capsicum yield (12.96 mt/ha)

KEYWORDS: *pod yield, pod length, split application*

INTRODUCTION

Nitrogen promotes rapid growth, increases leaf size and quality, hastens crop maturity, promotes fruit and seed development. Nitrogen is a constituent of amino acids, which are required to synthesize proteins and other related compounds and it plays a role in almost all plant metabolic processes. Nitrogen is highly vulnerable to losses .Split nitrogen (N) fertilizer applications can play an important role in a nutrient management strategy that is productive, profitable and environmentally responsible. Dividing total nitrogen application into two or more times can help growers enhance nutrient efficiency, promote optimum yields and mitigate the loss of nutrients. By more specifically synchronizing nitrogen supply with a plant's ability to utilize nutrients, split application can be an important component of 4R Nutrient Stewardship, right source, right rate, right time and right place(Tanner *et al* 2012). Among these 4R's Proper N application timing and rates are critical for meeting crop needs, and indicate considerable opportunities for improving nitrogen use efficiency (NUE) (Blankenau *et al.*, 2002). Growth stage of plants at the time of application determines NUE. (Kumari *et al.*, 2000). Optimizing timing, quantity and availability of applied nitrogen is the key to achieving high recovery efficiencies, increased agronomic efficiency and the overall NUE. Split application avoids excessive leaching losses, increases NUE due to decreased chances for nitrogen losses through leaching, runoff and gaseous emissions. Greater synchrony between crop nitrogen demand nitrogen rates and application times and N supply from all sources during the growing season would increase overall NUE (Adebayo *et al* 2007).

Capsicum is a crop which gives a high yield more than 90 days. The yield may be differentiated according to the application of nitrogen fertilizer on it. Although the Department of Agriculture (DOA) recommends to use nitrogen fertilizer, only a few farmers follow it. Most of the farmers use nitrogen fertilizer at their own way. Their object is to maximize their yield. Hence, they tend to use nitrogen fertilizer regardless of the recommendation of Department of Agriculture.

Therefore, the current study was proposed to clarify the effect of basal and split application of different nitrogen rates on growth and effect of increasing the terms of applying nitrogen after the planting of capsicum and quantify the appropriate nitrogen for top dress on capsicum.

METHODOLOGY

Experimentation

This experiment was conducted as field experiment. The Randomized complete Block Design (RCBD) was used as the experimental design. The six treatments were randomized completely within each block separately and were replicated three times. The treatments were selected according to the nitrogen requirement of plant. The overall rate of nitrogen was applied 160 kg/ha through urea and fertilizer treatments consisted 5 levels of nitrogen (0, 40, 80, 120, 160kg/ha). These rates were applied as the basal fertilizer and the remaining quota of nitrogen fertilizer was split in to 4 times up to 160kg/ha at every three weeks. One treatment (T6) was maintained according to the recommended rate. Other major nutrients P and K were applied at the rate of 60 kg/ha and 120Kg/ha through triple super phosphate (TSP), muriate of potash (MOP).

Table 1: Treatments in the Experiment

Treatment	Basal Application (kg/ha)	3 WAP (kg/ha)	6 WAP (kg/ha)	9 WAP (kg/ha)	12 WAP (kg/ha)
T_1	0 N + 60 P + 40 K	0 N + 40 K	0 N + 40 K	0 N	0 N
T_2	40 N + 60 P + 40 K	30 N + 40 K	30 N + 40 K	30 N	30 N
T_3	80 N + 60 P + 40 K	20 N + 40 K	20 N + 40 K	20 N	20 N
T_4	120 N + 60 P +40 K	10 N + 40 K	10 N + 40 K	10 N	10 N
T_5	160 N + 60 P + 40 K	0 N + 40 K	0 N + 40 K	0 N	0 N
T_6	DOA Recommendation (135 kg/ha N + 60 kg/ha P + 120 kg/ha K)				

Planting and spacing

Capsicum variety CA- 8 vas selected for this experiment. Individual plot size was 1.6m × 2.8m.Each plot was maintained with 28 plants at a spacing of 40 cm and 40 cm between the rows and plants, separately. Plot was separated by the ground channels which separated the treated area in order to prevent the treatment effect in any adjacent plots to influence the experiment.

Yield Records

Yield records were maintained throughout the experimental period. Fruits were harvested at 8 days intervals during maturity to ripening stage. The area was well prepared maturity of the crop was determined on the basis of size of fruits. Fruits yield were taken from net plot area which include 10 plants. Matured pods were collected from net plot area and measured separately in each replicate of first to fifth harvesting time.Net plot yield was measured from the harvested central unit areas of 1.6 m^2 and samples were weighed using an electronic balance.

RESULT AND DISCUSSION

Total yield of capsicum

Capsicum yield was significantly ($p < 0.05$) affected due to the treatments applied. The analysis of variance showed significant responses to N application (Figure 1). Increasing rate of nitrogen application increased the capsicum yield significantly. The sequential split of N showed a significant effect ($p<0.05$) on capsicum yield and the highest value was obtained with T_3 (80 kg N/ha as basal + 4 splits of 20 kg N/ha), compares to T_1 control and T_6 department recommendation. Results revealed that the application of 20kg N/ha sequential splits can attributed a better and continuous supply of N to plants during growth and development consequently increasing the yield. Parthiban, (1991) reported that application of N in three split doses as conducive for regulating the supply of fertilizer N over almost whole the active growth phase of the plant.

There was a large yield reductions in control compared to fertilized plots. This may be due to the unavailability of sufficient nutrients. Initial soil analysis were indicated moderate organic matter content at experimental site. The nutritional requirements of capsicum cannot be fulfilled by the native soil nutrients and thus cannot alter all the biometric characters which are highly influencing on yield of capsicum. It was found that greater nitrogen recovery oh split application of nitrogen fertilizer on capsicum was found when it was incorporated into soil (Siti et al 1993) and reduces the losses and increase the uptake of nutrient thus increase the yield of crops.

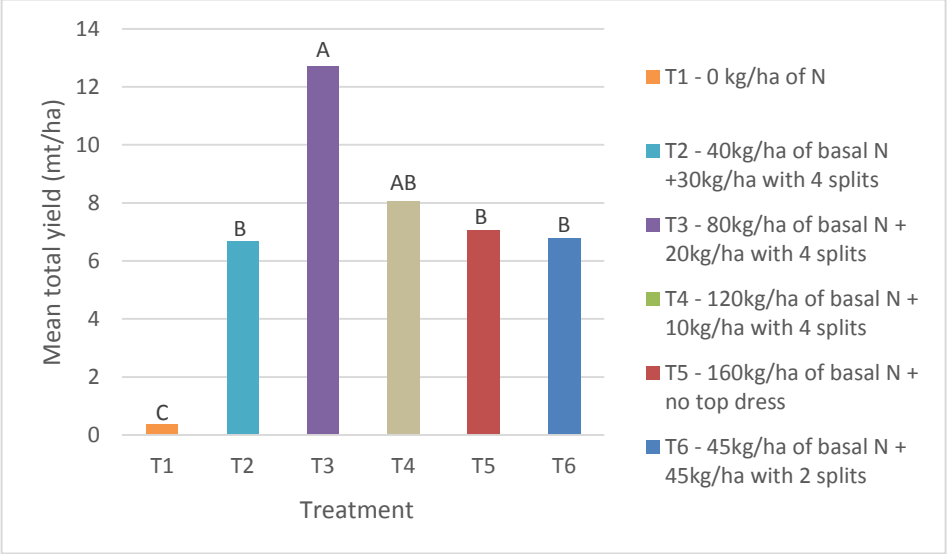

Figure 1: Effect of basal N quantity and sequential N splits for total yield (mt/ha)

Mean values in a bar having the similar letter/letters indicate non-significant differences at 5% level of significance by Duncan.

Higher response of capsicum to different times of N application may indicate the growth and yield enhancing effect of N splits. This may be attributed to the synchrony between the time of N need of the plant and the availability of sufficient N. Thus, at the time of high need for N, the plant may have taken most of the N from the soil that might have avoided the leaching of the nutrient. If the sequential split application of N is coincide with requirement of N in plant, it may cause typically high uptake and as well as deduction of leaching. This process may be the reason for significant Reports indicated that in-season N application improves synchrony between crop demand and nutrient

supply, especially in high rainfall areas where nitrate leaching is very common, was meant to enhance crop yield by improving N use efficiency (Zafar and Chaudhary, 2007). Thus, there could be more potential to increase the productivity of capsicum with use higher rates of N fertilizer with five split applications.

Yield of first pick

Figure 2 shows the effect of different rates of basal nitrogen and split nitrogen application on yield of capsicum. The results pertaining to the pod yield of first pick on capsicum revealed that, there was significant influence of different nitrogen rates on yield of capsicum.

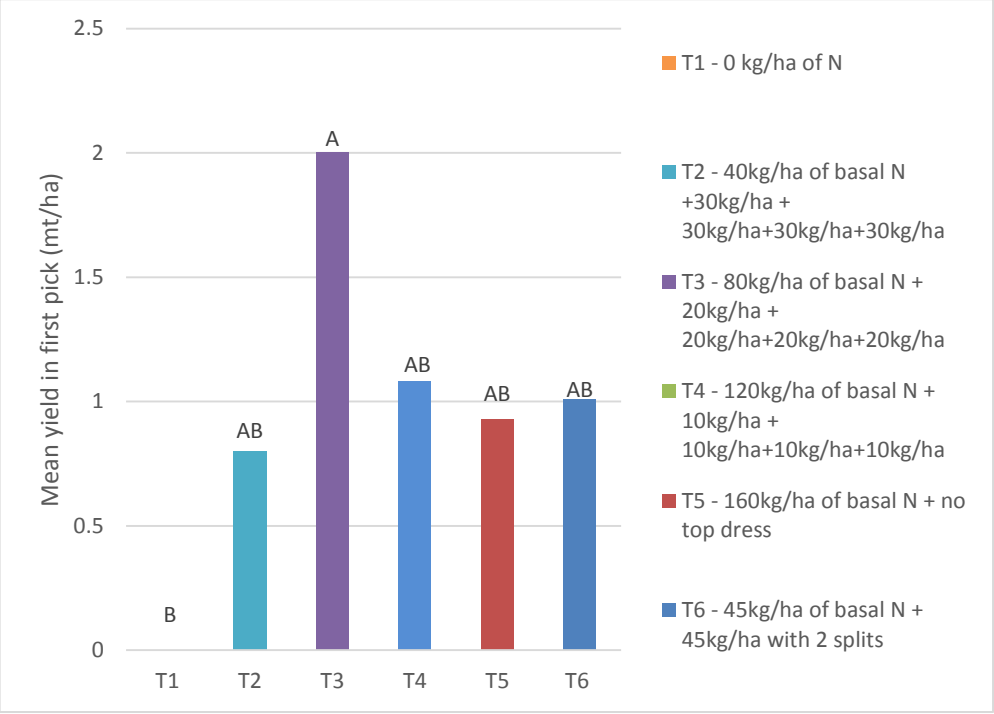

Figure 2: Effect of basal N and 2 top dress N quantity for first yield (mt/ha)

Bar having the similar letter/letters indicate non-significant differences at 5% level of significance by Duncan.

First and second top dress with basal nitrogen was applied before the crop first pick. Figure 2 shows that maximum yield was obtained from T_3. This treatment received 80kg N/ha as basal and 20kg N/ha as though two splits. This result confirmed with Adetula and Olakojo (2006) who suggested that the best way of fertilizer application is once and 3 weeks after planting. First pick yield was low in 40kg N/ha as basal with 30kg N/ha top dress. This shows, that 40kg N/ha as basal N was not sufficient to generally a good crop and yield. Figure 4.2 further showed that T_4 and T_5 application of very high basal (120kg N/ha and 160kg N/ha) was also not productive. In T_4, 120kg N/ha as basal and of 10kg N/ha quantity through 2 splits up to first harvest. It was found that greater nitrogen recovery of split application of nitrogen fertilizer on capsicum was found when it was incorporated into soil (Libnernonneke, 1989) and reduces the losses and increase the uptake of nutrients thus increase the yield of crops.

Number of pods per plant

The number of pods is an important yield component of capsicum. There were significant differences ($P<0.05$) among treatments on number of pods (Table 2). The highest number of pods per plant (128.67) was found with treatment three (T_3 = 80kg N/ha as basal + 4 splits of 20kg N/ha) and the lowest number of fruits per plant (5.00) was found in control treatment. Number of fruits per plant increased gradually with the increase in basal and top dress nitrogen dose. These results are consistent with those reported by Mavengahama *et al* (2003) who reported deferent rates of basal nitrogen fertilizer application significantly ($p<0.05$) affected paprika fruit yields.

Table 2: Effect of basal N quantity and sequential N splits for number of pods per plant (pods/plant)

Treatment	Description	Mean number of pods per plant
T_1	0kg/ha	5 ^{C}
T_2	40kg/ha of basal N + 30kg/ha with 4 splits	76.33 ^{B}
T_3	80kg/ha of basal N + 20kg/ha with 4 splits	128.67 ^{A}
T_4	120kg/ha of basal N + 10kg/ha with 4 splits	84.33 ^{AB}
T_5	160kg/ha of basal N + no top dress	72.67 ^{B}
T_6	45kg/ha of basal N + 45kg/ha with 2 splits	84.67 ^{AB}

Mean values in a column followed by the same letter(s) within treatment group are not significantly different at 5% level of significance by Duncan Test.

This result suggests that N application to the soil is important to improve fruit yield and yield components of capsicum. This might be due to the fact that nitrogen is an integral component of many essential plant compounds like chlorophyll, proteins and it is a major part of all amino acids (Brady and Weil, 2002). It increases the vegetative growth and produces good quality foliage and promotes carbohydrate synthesis through photosynthesis and ultimately increased yield of plants (Mengel and Kirkby, 1987). This result also agree with Baghour *et al.* (2001) who reported that fruit setting in pepper was related to phytohormone activity and N nutrition.

Pod length

According to the Duncan test it was observed that there were appreciable difference in length of pods due to the different basal nitrogen rates with sequential N splits in first to fifth harvest (Table 3). The fruit length was significantly affected by the levels of nitrogen.

Table 3: Effect of basal N quantity and sequential N splits for pod length (cm)

	Mean values of Pod length (cm)				
Treatment	1st harvest	2nd harvest	3rd harvest	4th harvest	5th harvest
T_1	-	-	-	-	8.19^{BC}
T_2	12.08^{AB}	10.65^{A}	11.18^{AB}	9.96^{A}	8.76^{C}
T_3	11.57^{BC}	11.92^{A}	11.1^{AB}	11.6^{A}	10.34^{A}
T_4	11.21^{C}	12.08^{A}	11.83^{A}	11.16^{A}	9.67^{AB}
T_5	11.19^{C}	11.2^{A}	11.92^{A}	9.72^{A}	10.1^{AB}
T_6	12.32^{A}	11.54^{A}	10.08^{B}	10.21^{A}	9.65^{AB}

Mean values in a column followed by the same letter(s) within treatment group are not significantly different at 5% level of significance by Duncan Test.

According to Table 3 that shows overall pods length were gradually decreased in each harvest time. Results revealed that or at lower levels of N, shorter pods were formed (T_5, T_1 and T_2) in fifth harvest. In the third harvest, there was significant difference among the treatments and the highest pod length was recorded from fifth treatment (160kg/ha of basal N + no top dress) and lowest pod length was recorded from DOA nitrogen recommendation treatment. The results are to some extent in agreement with Bhujbal (1995) reported 4 split application of N increased individual fruit weight and diameter in pomegranate. The increase in yield from N application was due to better and earlier canopy formation which checked the growth and reduced competition for nutrients from weeds while increased number of fruits and larger fruit size was attributed to a higher number of fruiting buds which ultimately raised fruit output (Jovicich et al., 2003).

Pod girth

Nitrogen significantly ($P < 0.05$) effected to increase pod diameter/width. Thus, increasing nitrogen quantity for basal that resulted increase in pod width compared to the control treatment. Pod widths at all treatment were in statistical parity (Table 4).

Table 4: Effect of basal N quantity and sequential N splits for pod girth (cm)

	Mean values of Pod Girth(cm)				
Treatment	**1st harvest**	**2nd harvest**	**3rd harvest**	**4th harvest**	**5th harvest**
T_1	-	-	-	-	6.16^{B}
T_2	7.38^{A}	7.18^{B}	7.74^{A}	6.69^{B}	6.27^{B}
T_3	8.21^{A}	8.20^{A}	7.82^{A}	7.61^{A}	7.05^{A}
T_4	8.09^{A}	7.66^{AB}	7.40^{A}	7.32^{AB}	6.50^{AB}
T_5	7.59^{A}	7.80^{AB}	7.83^{A}	7.51^{AB}	6.37^{B}
T_6	7.65^{A}	7.80^{AB}	7.73^{A}	7.04^{AB}	6.32^{B}

Mean values in a column followed by the same letter(s) within treatment group are not significantly different at 5% level of significance by Duncan Test.

The increased in pod width with increased basal with sequential nitrogen application could be attributed to enhanced assimilates partitioning by plants grown on plots with adequate nitrogen levels. DOA recommendation treatment was recorded lowest pod girth than the treatment three (T_3 = basal 80kg/ha N + top dress 20kg/ha with 4 splits) pod girth in each harvest time. This result tallied with Aujla et al. (2007) who also reported increase in average fruit weight and volume of pepper through increasing basal and top dress the rate of nitrogen fertilizer application. However, compare with each harvest time separately (Table 4.) shows there were fluctuation on pod girth among the treatment. This observation is in agreement with Tiamiyu *et al.* (2012) who recorded pod length and girth differences among the treatments are significant as far as market quality is concerned.

CONCLUSION

CA-8 capsicum variety which gives a 6-8mt/ha yield of 8-10 harvest terms through the application of nitrogen quantity on the recommendation rate. Yet, this research revealed that CA-8 variety can give 12mt/ha more yield at the five harvest period by application of 80kg N/ha as basal and 4 splits of 20kg N/ha. Fertilizer recommendation of CA-8 was 45kg N/ha as basal with two top dress of 45kg N/ha for capsicum. This experiment showed the best application would be 160kg N/ha through 80kg N/ha as basal and 4 splits of 20kg N/ha. Further, this study divulged yield was depended on rate and time of N application. Also, there is a clear impact of quantity of basal alone N application was not sufficient to the capsicum yield.

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