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STANDARDIZATION OF NPK DOSES FOR BETTER YIELD AND QUALITY SEED OF HYBRID CHILI

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ABSTRACT

The effect of NPK fertilize on quality seed production of chilies (*Capsicum fruescens* L.) (cv. Sonic) crossing male line (LTSL-004-M) and female line (LTSL-004-F) was evaluated at Germplasm Centre and Plant Biotechnology Lab, Department of Horticulture, PSTU during the period from November 2014 to October 2015. Ten different treatments of NPK fertilizer *viz.* T_1: 110 kg N + 175 kg P + 96 kg K ha^{-1}, T_2: 119 kg N + 210 kg P + 96 kg K ha^{-1}, T_3: 132 kg N + 175 kg P + 96 kg K ha^{-1}, T_4: 145 kg N + 175 kg P + 96 kg K ha^{-1}, T_5: 110 kg N + 190 kg P + 96 kg K ha^{-1}, T_6: 110 kg N + 210 kg P + 96 kg K ha^{-1}, T_7: 110 kg N + 231 kg P + 96 kg K ha^{-1}, T_8: 110 kg N + 175 kg P + 104 kg K ha^{-1}, T_9: 110 kg N + 175 kg P + 115 kg K ha^{-1} and T_{10}: 110 kg N + 175 kg P + 127 kg K ha^{-1} were used in this experiment. The study revealed that T4 produced the highest yield of seed (40.27 kg ha^{-1}), which is statistical similar to T_8. In seed viability characteristics, T_9 treated seeds showed the highest germination (100, 97.33 and 94.97%) at 1st (after harvest), 2nd (2 MAH- Month after harvest) and 3rd (4 MAH) observations, respectively. The T_3 treated seeds performed well in respect of Seed Vigor Index (SVI) at 1st and 2nd observations (8.00 and 7.48, respectively) but T_9 at 3rd observation.
Key words: NPK fertilizer, chili, seed yield, germination, viability, vigor.

Introduction

Chilies (*Capsicum frutescens* L.) is the third important crop of family Solanaceae after tomato and potato (Naz, 2006). It grows best on a well drained, silt or clay loam soil. The yield of Chilies depends on adequate supply of the essential nutrients (Alabi, 2006). Nutrient supply is an important aspect of the improved technologies developed and whose widespread adoption continues to ensure higher fruit yields, better quality and yield stability. Nitrogen plays a vital role as a constituent of protein, nucleic acid and chlorophyll (Devlin, 1972). Adequate nitrogen increases the quality, fruit size, keeping quality, color and taste (Shukla and Nair, 1993). Nitrogen influences flower development of several vegetable crops including pepper, tomato and cucumber (Kinet *et al*., 1985). Phosphorus is also one of the important macro essential elements for normal growth and development of plant (Bose and Som, 1986). The effect of phosphorus on the formation and translocation of carbohydrates, roots development, nodulation, growth and other agronomic characters are well recognized. Phosphorus induces earliness in flowering and fruiting including seed formation (Buckman and Brady, 1980). Again secondary mechanism of interference was the absorption of phosphorus from the soil through luxury consumption, increasing the tissue content without enhancing smooth biomass accumulation (Santos *et al*., 2004). The high quality of seed in terms of viability and vigor are the essential factors which determine the seedling development in nursery and plant establishment in the field to get higher yield with high quality seed (Kodalli, 2006). Payerol and Bhangoo (1990) reported that there was gradual decrease in viability parameters of chili seed starting from 6 months to 20 months of ambient storage. The scientists of Lal Teer Seed Limited are trying their best to identify high yielding variety through their research works. In present, the scientists of Lal Teer Seed Limited have already identified and producing some high yielding varieties and some hybrid varieties through CMS (Cytoplasmic Male Sterility) line by hand pollination method. But in respect of hybrid seed they are facing continuous losing seed viability problem in course of time. Up to three months of producing about 90% seeds are germinated but after that, it starts to reduce. So they cannot ensure the farmers to supply hybrid seed against their requirement. Therefore, the main objectives of the investigation were to standardize the different combinations of NPK fertilizers to produce good quality F_1 seed from CMS line and assure long storage.

Materials and Methods

The effect of NPK fertilizer on quality seed production and long time storage of chili (*Capsicum frutescens* L.) seed was conducted at Germplasm Centre and Plant Biotechnology Lab., Department of Horticulture, PSTU during November 2014 to October, 2015. The experiment was laid out in Randomized Complete Block Design (RCBD) consisting of single factor with 10 treatment combinations and was replicated three times. The planting material parental line as female line (LTSL-004-F) and male line (LTSL-004-M) were used for seedling rising of Lal Teer Seed Ltd, Zonal office Vanga, Faridpur. Ten different treatments of NPK fertilizer *viz.* T_1: 110 kg N + 175 kg P + 96 kg K ha^{-1}, T_2: 119 kg N + 210 kg P + 96 kg K ha^{-1}, T_3: 132 kg N + 175 kg P + 96 kg K ha^{-1}, T_4: 145 kg N + 175 kg P + 96 kg K ha^{-1}, T_5: 110 kg N + 190 kg P + 96 kg K ha^{-1}, T_6: 110 kg N + 210 kg P + 96 kg K ha^{-1}, T_7: 110 kg N + 231 kg P + 96 kg K ha^{-1}, T_8: 110 kg N + 175 kg P + 104 kg K ha^{-1}, T_9: 110 kg N + 175 kg P + 115 kg K ha^{-1} and T_{10}: 110 kg N + 175 kg P + 127 kg K ha^{-1} were used in this experiment. The unit plot size was 1.0m×1.0m accommodating 4 plants per plot with a spacing of 50 cm×50 cm excluding the spacing related experiments. All the standard cultural practices i.e. hoeing, weeding etc were performed regularly. Harvesting was done when the fruits were turned from green to red. Seeds were extracted by hand cutter from the fruits and separated seeds were washed from with a series of water washes. Then dried and stored for the measurement of quality characteristics of harvested chili seeds. The germination percentage indicates the number of seeds, which have produced normal seedling within the period (3–12 days) following formula described by ISTA (2006) as follows:

$$\text{Germination percentage} = \frac{\text{Number of seeds germinated}}{\text{Number of seed tested}} \times 100$$

An index of the speed of germination was calculated by adding the quotients of the daily counts divided by the number of days of germination using the formula (Agrawal, 1999) as follows:

$$\text{Vigour index} = \frac{\text{Number of seeds germinated (1st count)}}{\text{Number of days to first count}} + \cdots + \frac{\text{Number of seeds germinated (last count)}}{\text{Number of days to last count}}$$

Collected data from each experiment were statistically analyzed as per design of experiment using the MSTATC program. The significance of difference between pair of means was performed by the Least Significant Difference (LSD) test taking the probability level 5% and 1% as minimum unit of significance (Gomez and Gomez, 1984).

Results and Discussion

Number of hybrid fruits: Number of hybrid fruits $plant^{-1}$ was significantly varied from 8.00 to 12.33 due to the combined fertilizer application of NPK (Table 1). The plants of chill produced more number of fruits $plant^{-1}$ during the study but all of them are not allowed as hybrid fruits. The hybrid fruits were selected such a techniques as described in materials and methods section. Therefore, obtained result revealed that the application of 145 kg N ha^{-1} + 175 kg P ha^{-1} + 96 kg K ha^{-1} (T_4) produced the highest number of hybrid fruits $plant^{-1}$ (12.33) while 110 kg N ha^{-1} + 175 kg P ha^{-1} + 115 kg K ha^{-1} (T_9) showed the same highest (12.33) number of hybrid fruits $plant^{-1}$. On the other hand, only recommended dose of NPK (110:175:96) recorded the lowest number of hybrid fruits $plant^{-1}$ (8.00) which was significantly differed from other all NPK treatments. This result revealed that the over recommended doses of N or K were more effective for obtaining the more hybrids fruits which might be due to the over recommended doses of N or K had more effective for higher photosynthesis and proper vegetative growth. The healthier plants of chilli produced more hybrid fruits. The results were supported by Rahman *et al*. (2012).

1000–seed weight: The data on weight of thousand seeds did not vary significant among the recommended and over doses treatments of NPK fertilizers (Table 1). It was found might be due to the seeds of chilli in were collected only from hybrid seeds as well as their seeds did not more differed in size and weight.

Seed yield: Seed yield varied significantly from 14.33 to 40.27 kg ha^{-1} due to the effect NPK fertilizer (Table 1). The treatment T4 obtained the highest yield of seed (40.27 kg ha^{-1}) but T8 produced statistically identical seed production (40.14 kg ha^{-1}). Recommended dose of NPK produced the lowest production of chilli seed (14.33 kg ha^{-1}). This result revealed that over recommended dose of N and K were produced greater production of chilli which might be due to over doses of N and K were more effective for higher vegetative growth of chilli along with more flower and hybrid fruits production. Similar result was found by Rahman *et al*. (2012) who found that the highest vegetative growth influenced the total yield of pepper.

Germination (%)/Seed emergence: Observations revealed significant different due to the effect of NPK fertilizer treated seeds during field trial. Result showed that the 110 kg N ha^{-1} + 175 kg P ha^{-1} + 115 kg N ha^{-1} (T_9) treated seeds of chili in field level produced the highest germination (100, 97.33 and 94.67%) at after harvest and at 2 and 4 months after harvest (MAH), respectively. On the other hand, the recommended NPK fertilizer treated seeds of chili showed the lowest germination (93.33, 90.00 and 83.33%) at those periods, respectively (Table 2). This result revealed that the over recommended K level had more capability to hold the quality of seed in long time storage under ambient condition. Besides, this germination percentage significantly decreased the germination ability with the increasing periods of storage time which might be due to the loss of seed quality along with the decreasing possibility of moisture. Similar result was found by Kumari *et al.* (2014) where there was gradual decrease in all the above viability parameters of chili seed starting from 6 months to 20 months of ambient storage.

Table 1. Effect of different levels of NPK fertilizer on yield and quality of chilli

NPK fertilizer (kg ha^{-1})	No. of hybrid fruits $plant^{-1}$	1000-seed weight (g)	Seed yield (kg ha^{-1})
T_1	8.00	4.89	14.33
T_2	10.00	4.89	22.83
T_3	12.00	4.90	37.26
T_4	12.33	4.92	40.27
T_5	11.67	4.89	39.57
T_6	11.33	4.90	37.66
T_7	10.00	4.90	35.45
T_8	10.00	4.89	40.14
T_9	12.33	4.89	34.76
T_{10}	11.00	4.90	39.21
CV (%)	8.62	1.15	2.78
Level of significance	**	ns	**

Table 2. Effect of NPK fertilizer on percentage of seed germination and seed vigor index of chilli at different months after harvest (MAH)

NPK fertilizer (kg ha^{-1})	% seed germination			Seed vigor index		
	After harvest	2 MAH	4 MAH	After harvest	2 MAH	4 MAH
T_1	93.33	90.00	83.33	6.31	5.87	5.29
T_2	98.00	94.67	89.33	7.54	6.91	5.89
T_3	98.67	96.00	92.67	8.01	7.48	5.66
T_4	97.33	93.33	90.00	7.19	6.72	5.52
T_5	98.67	96.00	92.00	7.32	7.00	5.90
T_6	98.67	95.33	92.67	7.96	7.61	6.18
T_7	96.00	92.67	88.67	6.92	6.52	5.81
T_8	97.33	94.00	89.33	6.75	6.36	5.77
T_9	100.00	97.33	94.67	7.97	7.69	6.32
T_{10}	98.00	93.33	88.67	7.02	6.34	5.80
CV (%)	1.92	2.45	2.59	6.19	6.28	4.82
Level of sig.	*	*	**	**	**	**

CV = Co-efficient of variation; **= Significant at 1% level of probability and ns = non significant

Seed vigor index (SVI): SVI were observed as observation of seed viability. SVI were calculated from the periods of germination observation while observation of seed germination continue up to 12 days of each germination period of after harvest, 2 and 4 MAH, respectively. SVI revealed significant variation among the different levels of NPK fertilizer. The collected seeds treated by 132 kg N ha^{-1} + 175 kg P ha^{-1} + 96 kg N ha^{-1}showed the highest SVI at first observation after harvest (8.01) and at 2 MAH (7.48) but the treated seeds of 110 kg N ha^{-1} + 175 kg P ha^{-1} + 115 kg N ha^{-1} (T_9) gave SVI at 4 MAH (6.32). It was gradually decreased with the increasing storage period at 4 MAH. It decreased rapidly compared to first and second observation which might be due to the storage seeds of chili decrease their germination ability in longer storage (Table 2).

Conclusion

The application of 110 kg N ha^{-1} + 175 kg P ha^{-1} + 115 kg K ha^{-1} may be recommended at farmers' level in terms of longer seed viability with higher seed germination rate. Besides, farmers will be able to be produced more quality seeds and stored in their own house at ambient condition for long time viability. Satisfaction of NPK doses for further study could accelerate hybrid seed production of chili for increasing long time seed viability.

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