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# EFFECT OF NPK ON GROWTH, YIELD AND SEED QUALITY OF HYBRID CHILLI

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**Abstract**

An experiment was carried out at Germplasm Centre and Plant Biotechnology Lab, Department of Horticulture, PSTU to evaluate the growth, seed yield and quality of hybrid F1 chilli (cv. Sonic) crossing male line (LTSL-004-M) and female line (LTSL-004-F) along the viability of productive seeds influenced by NPK fertilizers during the period from November 2015 to October 2016. Ten different treatments of NPK fertilizers were used. Result showed that all the characteristics except primary branches and1000 seed weight were influenced significantly due to the application of NPK fertilizers. The tallest plant (69.88 cm), more leaves plant$^{-1}$ (2491.33), highest number of secondary branches plant$^{-1}$, tertiary branches plant$^{-1}$ (5.00 and 88.00, respectively), number of flowers and hybrid fruits plant$^{-1}$ (1533.00 and 12.33, respectively) and weight of seeds (4.03 g plant$^{-1}$) along with required more time (54.67 days) for flowering were obtained from the application of 145 kg N ha$^{-1}$, 175 kg P ha$^{-1}$ and 96 kg K ha$^{-1}$ (T4) which produced the highest final seed yield of chilli (4.03 kg ha$^{-1}$). Application of T5 and T9 showed the highest number of primary branches (2.33). In seed viability characteristics T9 treated seeds showed the highest germination (100, 97.33 and 94.97%) at 1st, (1 MAH - Month After Harvest), 2nd (2 MAH) and 3rd (4 MAH) observations, respectively. The T3 treated seeds performed well in respect of Seed Vigour Index (SVI) at 1st and 2nd observations (8.00 and 7.48, respectively) but T9 treated seeds showed the highest SVI (6.32) at 3rd observation. Above indicating all characteristics were lowest under only recommended doses of NPK T1 as control treatment except days to first flowering. The observations suggested that production of hybrid chilli seeds could be enhanced by applying T4. While seeds of chilli treated by T9 in field level showed long time viable. Application of 145 kg N ha$^{-1}$, 175 kg P ha$^{-1}$ and 96 kg K ha$^{-1}$ may be suggested for seed production of chilli and 110 kg N ha$^{-1}$, + 175 kg P ha$^{-1}$ + 115 kg K ha$^{-1}$ for keeping the long time seed viability.

**Keywords**: NPK fertilizers, Parental line of chilli seedling, Growth parameters, Yield, Seed viability

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## Introduction



the improved
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areas and seasons in Bangladesh (Asaduzzaman *et al.*, 2010). It occupies 1.05 lakh hectares of land and the production of chilli is about 1.76 lakh metric tons during the year of 2010-11 but about 60% yields could be lost due to improper time of weeding and management (BBS, 2012). With the increase of population, the demand of crop has been increasing day by day and the traditional varieties could not fulfill the demand due to their inherent low yield potential. The main reasons of low yield are lacking of high yielding varieties and use of appropriate dose of fertilizer. Nutrient adoption continues to ensure higher fruit yields, better quality and yield stability. Chilli requires continuous supply of N as a component of nutrition for production systems in which the aim to maintain good growth, maximum fruit yield and quality, especially the levels of secondary metabolites such as alkaloids (e.g. Capsaicin), phenols etc. The high quality of seed in terms of viability and vigour 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). Production of high quality seed is possible only by adopting scientific, cultural and improved agronomic management practices. Among several agronomic and management practices, the mother plant nutrition plays an important role for increasing production of quality seed. Seed yield and quality are known to vary with nutrient status of the soil and plant characters. Payerol and Bhangoo (1990) reported that effect of N differing by rates and frequencies of application on the yield and quality of chilli. They also found that there was gradual decrease in viability parameters of chilli seed starting from 6 months to 20 months of ambient storage. The scientists of LalTeer Seed Limited are trying their best to identify high yielding variety through their research works. In present, the scientists of LalTeer 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 due to seed viability problem in course of time. Up to three months of producing about 90%, seed germinate but the germinability of those seeds drastically fall in terms of time. After 3 months, it starts to reduce. So, they cannot ensure the farmers to supply hybrid seed against their requirement. Therefore, the main objectives of this present investigation were to produce good quality $F_1$ seed from CMS line with the effect of different doses of NPK fertilizers alone and combined effect on the plant growth, seed yield and seed quality in long time storage.

## Materials and Methods

The experiment was carried out at Germplasm Centre and Plant Biotechnology Laboratory, Department of Horticulture, PSTU during November 2014 to October, 2015. The planting material parental line as female line (LTSL-004-F) and male line (LTSL-004-M) were used for seedling raising at LalTeer Seed Ltd, Zonal office Vanga, Faridpur. The experiment consisting of single factor with 10 treatment combinations was laid out in RCBD with three replications. In each block the land was divided into ten plots for 10 treatments. There were total 30 plots. The unit plot size, manure and fertilizers excluding boron and zinc, other intercultural operations and plant protection measures taken were same as described. Treatments were assigned randomly to the unit plot. The unit plot size was 1.0 m × 1.0 m accommodating 4 plants per plot with a spacing of 50 cm × 50 cm excluding the spacing related experiments. Plot to plot distance was provided 50 cm while the block to block distance was 1m. Ten treatments of NPK fertilizer as follows;

$T_1$ (N=110 kg ha$^{-1}$; $P_2O_5$ =175 kg ha$^{-1}$; $K_2O$ =96 kg ha$^{-1}$),
$T_2$ (N=119 kg ha$^{-1}$; $P_2O_5$ =175 kg ha$^{-1}$; $K_2O$ =96 kg ha$^{-1}$),
$T_3$ (N=132 kg ha$^{-1}$ $P_2O_5$ =175 kg ha$^{-1}$; $K_2O$ =96 kg ha$^{-1}$),
$T_4$ (N=145 kg ha$^{-1}$; $P_2O_5$ =175 kg ha$^{-1}$; $K_2O$ =96 kg ha$^{-1}$),
$T_5$ (N=110 kg ha$^{-1}$; $P_2O_5$ =190 kg ha$^{-1}$; $K_2O$ =96 kg ha$^{-1}$),
$T_6$ (N=110 kg ha$^{-1}$; $P_2O_5$ =210 kg ha$^{-1}$; $K_2O$ =96 kg ha$^{-1}$),
$T_7$ (N=110 kg ha$^{-1}$; $P_2O_5$ =231 kg ha$^{-1}$; $K_2O$ =96 kg ha$^{-1}$),
$T_8$ (N=110 kg ha$^{-1}$; $P_2O_5$ =175 kg ha$^{-1}$; $K_2O$ =104 kg ha$^{-1}$),
$T_9$ (N=110 kg ha$^{-1}$; $P_2O_5$ =175 kg ha$^{-1}$; $K_2O$ =115 kg ha$^{-1}$),
$T_{10}$ (N=110 kg ha$^{-1}$; $P_2O_5$ =175 kg ha$^{-1}$; $K_2O$ =127 kg ha$^{-1}$)

Hybridization procedure was done using hand pollination method. Removal of male part of a chilli flower of female parents was done in the afternoon by forceps. Male parent flower buds that will open the following day were picked in the afternoon. Pollination was started at flower on third node. Holding the emasculated flower on the plant carefully, male flower taking from wet clothes was touches slowly as the stigma was not damaged. Post-pollination cultural management was done as required. 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 properly dried and stored scientifically for the measurement of quality characteristics of harvested chilli seeds. Data on growth, flowering behaviour and yield contributing attributes were collected from randomly selected 4 plants for each treatment in each replication on the parameters Plant height at harvest, Number of leaves plant$^{-1}$, Number of primary branches plant$^{-1}$, Number of secondary branches plant$^{-1}$, Number of tertiary branches plant$^{-1}$, Days to first flower initiation, Number of Pollinated flower plant$^{-1}$. Number of fruit set from pollinated flowers: Number, Seed yield and Weight of 1000 seeds. The harvested seed of the present field trial treated by N, P and K were used for further observation on the aspect of the quality test of germination percentage and seed vigor index as viability attributes. 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

### *Effect of NPK on morpho–physiological, yield and quality of chilli*

#### *Plant height (cm)*

Effect of different levels of NPK was significantly influenced the plant height of chilli in where it was significantly varied from 53.85 to 69.88 cm (Figure 1). From the above variation in plant height, it was found that the treatment $T_4$: 145 kg N ha$^{-1}$, 175 kg P ha$^{-1}$ and 96 kg K ha$^{-1}$ exhibited the tallest plant followed by the treatment $T_3$: 132 kg N ha$^{-1}$, 175 kg P ha$^{-1}$ and 96 kg K ha$^{-1}$ (67.95 cm) while recommended dose of NPK (110 kg N ha$^{-1}$, 175 kg P ha$^{-1}$ and 96 kg K ha$^{-1}$) produced the shortest plant. This could be due to higher availability of NPK and their uptake that progressively enhanced the plant height.

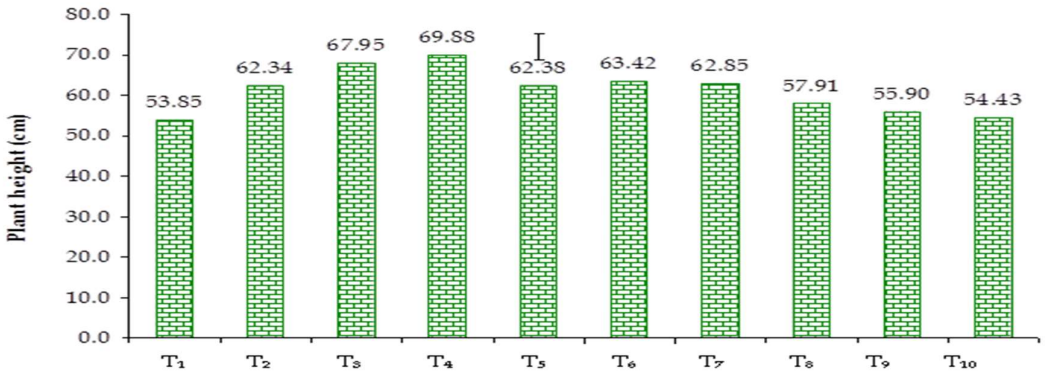


Figure 1. Effect of different levels of NPK fertilizers on plant height at harvest, Vertical bar represent LSD at 5% level of probability.

***Different levels of NPK fertilizers (kg ha⁻¹) Number of leaves plant⁻¹***

The data of leaf production plant⁻¹ revealed significant variation due to the combined application of NPK fertilizer where leaves plant⁻¹ of the present study significantly varied from 2334.67 to 2491.33 (Figure 2). The highest number of leaves plant⁻¹ was obtained from the application of 145 kg N ha⁻¹ + 175 kg P ha⁻¹ + 96 kg K ha⁻¹ ($T_4$) followed by the application of 110 kg N ha⁻¹ + 231 kg P ha⁻¹ + 96 kg K ha⁻¹ ($T_7$), 132 kg N ha⁻¹ + 175 kg P ha⁻¹ + 96 kg K ha⁻¹ ($T_3$), 110 kg N ha⁻¹ + 210 kg P ha⁻¹ + 96 kg K ha⁻¹ ($T_6$) and 119 kg N ha⁻¹ + 210 kg P ha⁻¹ + 96 kg K ha⁻¹ ($T_2$) (2481.67, 2447.67, 2426.33 and 2412.33, respectively). On the other hand, recommended dose of NPK (110 kg N ha⁻¹, 175 kg P ha⁻¹ and 96 kg K ha⁻¹) as control treatment showed the lowest number of leaves plant⁻¹. The above result revealed that the recommended dose of P and K along with upper doses of N perform well for the production of chilli leaves. Adeola *et al*. (2011) found significant variation in leaf production of chilli due to NPK fertilizer.

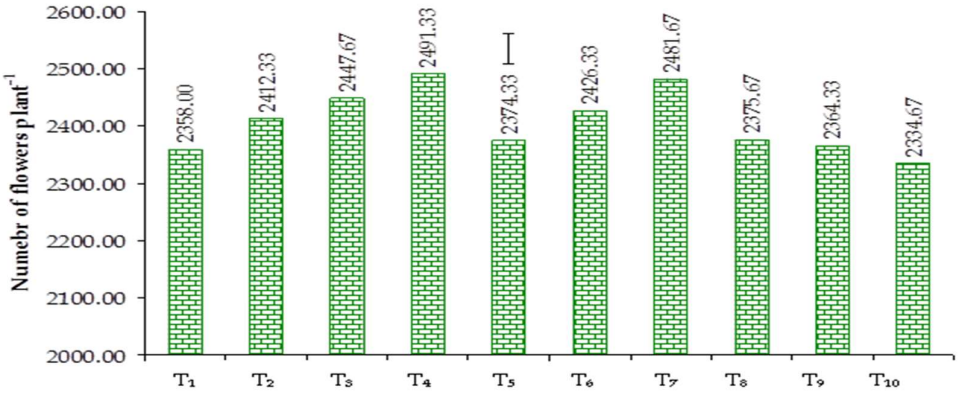


Figure 2. Effect of different levels of NPK fertilizers on number of leaves plant⁻¹ at harvest, Vertical bar represent LSD at 5% level of probability.

***Different levels of NPK fertilizers (kg ha⁻¹) Number of primary branches plant⁻¹***

Effect of NPK fertilizer was significantly influenced the number of primary branches plant⁻¹ and primary branches plant⁻¹ at harvest varied from 2.0 to 2.33 (Table 1). It was found that all the combined and recommended dose of fertilizer (RDF) application (control) treatment of NPK produced same (2.0) number of branches plant⁻¹ except NPK combination of 110 kg N ha⁻¹ + 175 kg P ha⁻¹ + 115 kg K ha⁻¹ ($T_9$) while treatment $T_9$ was the best for production of primary branch plant⁻¹ (2.33) (Table 1). This result indicated that the application of N had more efficient for proper growth of chilli which might be due to the application of N can uptake soil nutrients and enhanced the plant growth as well as they confirm more production of branches.

***Number of secondary branches plant⁻¹***

Secondary branches plant⁻¹ was statistically significant among the different combinations treatment of NPK and it was ranges of 4.00 to 5.00 (Table 1). However, 145 kg N ha⁻¹ + 175 kg P ha⁻¹ + 96 kg K ha⁻¹ ($T_4$) produced the highest number of branches plant⁻¹ but it was statistically differed from other treatments. Treatment $T_{10}$

(110 kg N ha$^{-1}$ + 175 kg P ha$^{-1}$ + 127 kg K ha$^{-1}$) showed the second highest while rest of the treatments of NPK showed same (4.33) number of secondary branches plant$^{-1}$ except $T_1$ (110 kg N ha$^{-1}$ + 175 kg P ha$^{-1}$ + 96 kg K ha$^{-1}$) and $T_2$ (119 kg N ha$^{-1}$ + 175 kg P ha$^{-1}$ + 96 kg K ha$^{-1}$). Therefore, the treatment $T_1$ and $T_2$ exhibited the same lowest number of secondary branches plant$^{-1}$ (Table 1).

### *Number of tertiary branches plant$^{-1}$*

Number of tertiary branches plant$^{-1}$ differed significantly due to the effect of different levels of NPK fertilizer combination (Table 1). Obtained result on number of tertiary branches plant$^{-1}$ have been presented in Table 1. The number of tertiary branches plant$^{-1}$ ranges from 74.00 to 88.00.Result revealed that the 145 kg N ha$^{-1}$ + 175 kg P ha$^{-1}$ + 96 kg K ha$^{-1}$ ($T_4$) recorded the highest and both 110 kg N ha$^{-1}$ + 175 kg P ha$^{-1}$ + 96 kg K ha$^{-1}$ ($T_1$) as control or (RDF of NPK) and 110 kg N ha$^{-1}$ + 175 kg P ha$^{-1}$ + 127 kg K ha$^{-1}$ ($T_{10}$) recorded the lowest number of tertiary branches plant$^{-1}$. However, 110 kg N ha$^{-1}$ + 210 kg P ha$^{-1}$ + 96 kg K ha$^{-1}$ ($T_6$) produced the second highest number of tertiary branches (86.33) but it was closely followed by 110 kg N ha$^{-1}$ + 231 kg P ha$^{-1}$ + 96 kg K ha$^{-1}$ (85.00).

Table1. Effect of different levels of NPK fertilizer on number of different types of branches plant$^{-1}$ and days to first flowering of chilli.

| Doses of NPK fertilizer (kg ha$^{-1}$) | No. of primary branches plant$^{-1}$ | No. of secondary branches plant$^{-1}$ | No. of tertiary branches plant$^{-1}$ | Days to first flowering |
|---|---|---|---|---|
| $T_1$ | 2.00 | 4.00 | 74.00 | 47.33 |
| $T_2$ | 2.00 | 4.00 | 78.67 | 52.00 |
| $T_3$ | 2.00 | 4.33 | 82.00 | 53.00 |
| $T_4$ | 2.00 | 5.00 | 88.00 | 54.67 |
| $T_5$ | 2.00 | 4.33 | 76.67 | 48.00 |
| $T_6$ | 2.00 | 4.33 | 86.33 | 43.00 |
| $T_7$ | 2.00 | 4.33 | 85.00 | 39.33 |
| $T_8$ | 2.00 | 4.33 | 78.33 | 46.00 |
| $T_9$ | 2.33 | 4.33 | 75.00 | 40.33 |
| $T_{10}$ | 2.00 | 4.67 | 74.00 | 35.00 |
| LSD $_{(0.05)}$ | 0.08 | 0.09 | 3.39 | 2.47 |
| LSD $_{(0.01)}$ | 0.11 | 0.13 | 4.65 | 3.38 |
| CV (%) | 1.99 | 1.26 | 2.48 | 3.13 |
| Level of significance | ** | ** | ** | ** |

*LSD $_{(0.05)}$ = Least significant difference at 5% level; LSD $_{(0.01)}$ = Least significant difference at 1% level; CV (%) = Co–efficient of variation and **= Significant at 1% level of probability.*

### *Days to first flowering*

Required days for first flowering were significantly influenced by the effect of NPK fertilizer at different level where 145 kg N ha$^{-1}$ + 175 kg P ha$^{-1}$ + 96 kg K ha$^{-1}$ (T4) needed more time (54.67 days) for first flowering followed (53.00 and 52.00 days) by 132 kg N ha$^{-1}$ + 175 kg P ha$^{-1}$ + 96 kg K ha$^{-1}$ (T3) and 119 kg N ha$^{-1}$ + 175 kg P ha$^{-1}$ + 96 kg K ha$^{-1}$ (T2), respectively. On the other hand, increment doses of K fertilizer (127 kg ha$^{-1}$) from recommended dose along with of N (110 kg ha$^{-1}$) and P (127 kg ha$^{-1}$) required least time for first flowering followed by upper levels of P (231 kg ha$^{-1}$) from recommended dose along with recommended N and K (T7). This result revealed that increasing level of N as compared to its recommended dose significantly increase the required time for flowering while upper level of K significantly decreased the time of first flowering. Besides, increasing N levels compared to its recommended dose significantly enhance the first flowering, which ultimately provide the proper time for plant maturity. Mature plant also produced healthy seeds which will improved the total yield. The findings of the present study agreed the findings of Singh *et al.* (1997).

### *Number of flowers plant$^{-1}$*

The production of flowers plant$^{-1}$ of chilli varied significantly due to the application of NPK fertilizer and it was ranges from 1242.33 to 1533.0 (Figure 3). Among the different treatments on NPK, maximum number of flowers plant$^{-1}$ (1533.00) was recorded from the combined application of 145 kg N ha$^{-1}$ + 175 kg P ha$^{-1}$ + 96 kg K ha$^{-1}$ ($T_4$) which was statistically differed from other all treatments while control treatment or only RDF (110 kg N ha$^{-1}$, 175 kg P ha$^{-1}$ and 96 kg K ha$^{-1}$) produced lowest number of flowers plant$^{-1}$ which followed (1271.00) by the combined application of 119 kg N ha$^{-1}$, 175 kg P ha$^{-1}$ and 96 kg K ha$^{-1}$ ($T_2$). The above finding was fully supported by the findings of Ayodele *et al.* (2015).

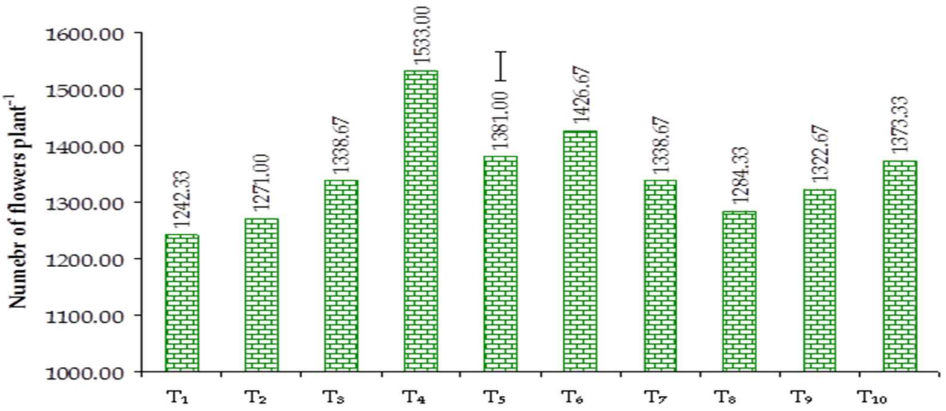


Figure 3. Effect of different levels of NPK fertilizers on number of flowers plant$^{-1}$ at harvest, Vertical bar represent LSD at 5% level of probability.

***Different levels of NPK fertilizers (kg ha$^{-1}$) Number of pollinated flowers plant$^{-1}$***

Number of pollinated flowers plant$^{-1}$ was also significantly influenced by the effect of NPK fertilizer and it varied significantly from 18.67 to 24.67 (Table 2). It was found that the highest number of pollinated flowers plant$^{-1}$ (24.67) was found from those chilli plant which was treated by 110 kg N ha$^{-1}$ + 190 kg P ha$^{-1}$ + 96 kg K ha$^{-1}$ (T5) which was closely (23.67) followed by the treated plant of 145 kg N ha$^{-1}$ + 175 kg P ha$^{-1}$ + 96 kg K ha$^{-1}$ (T4). On the other hand, 110 kg N ha$^{-1}$ + 175 kg P ha$^{-1}$ + 115 kg K ha$^{-1}$ (T9) showed the lowest number of pollinated flower plant$^{-1}$ (18.67) which indicated that the over doses of K (over up to 19 kg ha$^{-1}$) from recommended dose significantly decreased the pollinated flower production. It indicated that the increasing P dose (over up to 15 kg ha$^{-1}$) from its recommended dose significantly increased the production of pollinated flower of chilli. The over doses of P might be the cause to decrease the photosynthesis activity and reduce the effective flowers as well as more pollinated flowers.

***Number of hybrid fruits plant$^{-1}$***

Number of hybrid fruits plant$^{-1}$ was significantly varied from 8.00 to 12.33 due to the combined fertilizer application of NPK (Table 2). The plants of chilli produced more number of fruits plant$^{-1}$ during the study but not all of them are allowed as hybrid fruits. The hybrid fruits were selected from 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.

Table 2. Effect of different levels of NPK fertilizer on yield and quality of chilli.

| Doses of NPK fertilizer (kg ha$^{-1}$) | No. of pollinated flowers plant$^{-1}$ | No. of hybrid fruits plant$^{-1}$ | 1000 seed weight (g) | Seed yield (kg ha$^{-1}$) |
|---|---|---|---|---|
| $T_1$ | 19.00 | 8.00 | 4.89 | 14.33 |
| $T_2$ | 22.00 | 10.00 | 4.89 | 22.83 |
| $T_3$ | 22.00 | 12.00 | 4.90 | 37.26 |
| $T_4$ | 23.67 | 12.33 | 4.92 | 40.27 |
| $T_5$ | 24.67 | 11.67 | 4.89 | 39.57 |
| $T_6$ | 22.00 | 11.33 | 4.90 | 37.66 |
| $T_7$ | 22.33 | 10.00 | 4.90 | 35.45 |
| $T_8$ | 22.67 | 10.00 | 4.89 | 40.14 |
| $T_9$ | 18.67 | 12.33 | 4.89 | 34.76 |
| $T_{10}$ | 19.33 | 11.00 | 4.90 | 39.21 |
| LSD $_{(0.05)}$ | 2.04 | 1.61 | 0.10 | 1.63 |
| LSD $_{(0.01)}$ | 2.8 | 2.20 | 0.13 | 2.22 |
| CV (%) | 5.51 | 8.62 | 1.15 | 2.78 |
| Level of significance | ** | ** | ns | ** |

*LSD $_{(0.05)}$ = Least significant difference at 5% level; LSD $_{(0.01)}$ = Least significant difference at 1% level; CV (%) = Co–efficient of variation and **= Significant at 1% level of probability.*

### *Seed weight (g plant⁻¹)*

Seed weight (g plant⁻¹) of chilli was significantly affected by the effect of different NPK fertilizer levels and it was ranges from 1.47 to 4.03 g plant⁻¹ (Table 2). It was found that the treatment $T_4$ (145 kg N ha⁻¹ + 175 kg P ha⁻¹ + 96 kg K ha⁻¹) produced the average highest weight of seed in each plant (4.03 g plant⁻¹) while the treatment $T_4$ (110 kg N ha⁻¹ + 175 kg P ha⁻¹ + 104 kg K ha⁻¹) obtained the statistically same highest weight of seeds (4.02 g plant⁻¹) and it was followed (3.96 g plant⁻¹) by the treatment $T_5$ (110 kg N ha⁻¹ + 190 kg P ha⁻¹ + 96 kg K ha⁻¹). Similarly, RDF (110 kg N ha⁻¹, 175 kg P ha⁻¹ and 96 kg K ha⁻¹) as control treatment showed the lowest weight of seeds (1.47 g plant⁻¹) which was statistically significant with other NPK treatments. Johnson and Decoteau (1996) found that fruit count and fruit weight per plant increased linearly with increasing N rate.

### *Seed yield (kg ha⁻¹)*

Seed yield varied significantly from 14.33 to 40.27 kg ha⁻¹ due to the effect NPK fertilizer (Table 4.2).The 145 kg N ha⁻¹ + 175 kg P ha⁻¹ + 96 kg K ha⁻¹ (T4) obtained the highest yield of seed (40.27 kg ha⁻¹) but 110 kg N ha⁻¹ + 175 kg P ha⁻¹ + 104 kg K ha⁻¹ (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 produced highest yield of chilli seed. Theses over doses might be more effective for higher vegetative growth of chilli along with more flower and hybrid fruits production. It was observed that the combination of 145 kg N ha⁻¹ + 175 kg P ha⁻¹ + 96 kg K ha⁻¹ produced the tallest plant, more number of branches, highest number of flowers and hybrid fruits plant⁻¹ and highest weight of seeds which ultimately influence the total yield of chilli seeds.

### *Effect of NPK on viability characteristics of harvested chilli seed germination (%)*

Germination percentage of harvested chilli seeds were tested at just after harvest, 2 months after harvest (MAH) and 4 MAH which were treated by over recommended dose of NPK fertilizer as compared its recommended dose. The seeds of chilli were collected after harvest and stored in ambient condition of the Departmental Laboratory. Twelve day long observation was done for tested the seed germination as viability test during after harvest, 2 and 4 MAH. Thereafter number of germinated seeds of twelve days converted into percentage of seeds germination. Observation of germination percentage at different months after harvest revealed significant difference 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 K ha⁻¹ ($T_9$) treated seeds of chilli 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.

Table 3. Effect of different levels of NPK fertilizer on percentage of chilli seed germination.

| Doses of N fertilizer (kg ha⁻¹) | Germination (%) at different months after harvest | | |
|---|---|---|---|
| | After harvest | 2 | 4 |
| $T_1$ | 93.33 | 90.00 | 83.33 |
| $T_2$ | 98.00 | 94.67 | 89.33 |
| $T_3$ | 98.67 | 96.00 | 92.67 |
| $T_4$ | 97.33 | 93.33 | 90.00 |
| $T_5$ | 98.67 | 96.00 | 92.00 |
| $T_6$ | 98.67 | 95.33 | 92.67 |
| $T_7$ | 96.00 | 92.67 | 88.67 |
| $T_8$ | 97.33 | 94.00 | 89.33 |
| $T_9$ | 100.00 | 97.33 | 94.67 |
| $T_{10}$ | 98.00 | 93.33 | 88.67 |
| LSD $_{(0.05)}$ | 3.21 | 3.95 | 4.00 |
| LSD $_{(0.01)}$ | 4.40 | 5.42 | 5.48 |
| CV (%) | 1.92 | 2.45 | 2.59 |
| Level of significance | * | * | ** |

*LSD (0.05) = Least significant difference at 5% level; LSD (0.01) = Least significant difference at 1% level; CV = Co–efficient of variation and * & **= Significant at 5% and 1% level of probability, respectively.*

Table 4. Effect of different levels of NPK fertilizer on seed vigor index of chilli.

| Doses of N fertilizer (kg ha$^{-1}$) | Different months after harvest | | |
|---|---|---|---|
| | After harvest | 2 | 4 |
| $T_1$ | 6.31 | 5.87 | 5.29 |
| $T_2$ | 7.54 | 6.91 | 5.89 |
| $T_3$ | 8.01 | 7.48 | 5.66 |
| $T_4$ | 7.19 | 6.72 | 5.52 |
| $T_5$ | 7.32 | 7.00 | 5.90 |
| $T_6$ | 7.96 | 7.61 | 6.18 |
| $T_7$ | 6.92 | 6.52 | 5.81 |
| $T_8$ | 6.75 | 6.36 | 5.77 |
| $T_9$ | 7.97 | 7.69 | 6.32 |
| $T_{10}$ | 7.02 | 6.34 | 5.80 |
| LSD $_{(0.05)}$ | 0.77 | 0.74 | 0.48 |
| LSD $_{(0.01)}$ | 1.06 | 1.01 | 0.66 |
| CV (%) | 6.19 | 6.28 | 4.82 |
| Level of significance | ** | ** | ** |

*LSD $_{(0.05)}$ = Least significant difference at 5% level; LSD $_{(0.01)}$ = Least significant difference at 1% level; CV = Co–efficient of variation and **= Significant at 1% level of probability.*

### *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. 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 K ha$^{-1}$obtained the highest SVI during 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 K ha$^{-1}$ ($T_9$) keeping more SVI at 4 MAH (6.32). From the results it was observed that SVI gradually decreased with the increasing storage period and lower levels of NPK fertilizer treatment.

## Conclusion

It may be concluded that the application of 145 kg N ha$^{-1}$, 175 kg P ha$^{-1}$ and 96 kg K ha$^{-1}$ ($T_4$) were more successful NPK combination for better growth and higher seed production of chilli while 110 kg N ha$^{-1}$ + 175 kg P ha$^{-1}$ + 115 kg K ha$^{-1}$ ($T_9$) were more efficient for enhance the time of seed viability. The observation suggested that the production of hybrid chilli seeds can be more enhanced by applying over recommended dose of N along with recommended P and K fertilizer while seeds of chilli treated by over recommended dose of K along with recommended N and P in field level should be long time viable. So, the application of 145 kg N ha$^{-1}$, 175 kg P ha$^{-1}$ and 96 kg K ha$^{-1}$ may be recommended at farmers' level for profitable seed production of chilli under the AEZ–13 and 110 kg N ha$^{-1}$ + 175 kg P ha$^{-1}$ + 115 kg K ha$^{-1}$ for keeping the long time seed viability. Besides, farmers can be produced more hybrid $F_1$ or cultivable seed by applying this agronomical method and those seeds may be stored in their own house at ambient condition for long time viability. The findings of this research suggested that, further study might be needed to ensure the performance for observing the adaptability and quality of hybrid chilli seeds, under different AEZ of Bangladesh.

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