Effect of Vermicompost and Chemical Fertilizers on Growth, Yield and Yield Components of Potato in Barind Soils of Bangladesh


Dept. of Crop Science and Technology, University of Rajshahi, Rajshahi, Bangladesh.

Institute of Environmental Science, University of Rajshahi, Rajshahi, Bangladesh.

Dept. of Farm Structure, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Abstract: An experiment was conducted to study the effect of vermicompost and NPKS fertilizers on growth and yield of potato (cv. Cardinal) in Level Barind Tract (AEZ-25) soils of Bangladesh. The organic matter of the experimental field soil was very low and in case of N, P, K and S also low. The land was medium fertile and P was 5.4. There were 12 treatments viz. control (T0), vermicompost (VC) 2.5 t/ha (T1), VC 5.0 t/ha (T2), VC 10.0 t/ha (T3), VC 2.5 t/ha+50% NPKS (T4), VC 10 t/ha+50% NPKS (T5), VC 2.5 t/ha+100% NPKS (T6), VC 5 t/ha+100% NPKS (T7), VC 10 t/ha+100% NPKS (T8), 50% NPKS (T9) and 100% NPKS (T10). The experiment was laid out in RCBD with three replications. The doses of N-P-K-S were 90-40-100-18 kg/ha for potato. Application of vermicompost and NPKS significantly influenced the growth and yield of potato. The treatment T10 produced the highest (25.56 t/ha) tuber yield of potato. The lowest yield and yield contributing parameters recorded in control (T0). Application of various amounts of vermicompost (2.5, 5, 10 t/ha) with NPKS fertilizers (50% and 100%) increased the vegetative growth and yield potato. Vermicompost at 2.5 and 10 t/ha with 50% of NPKS increased tuber yield over control by 78.3, 96.9 and 119.5 t/ha respectively. And vermicompost at 2.5, 5 and 10 t/ha with 100% of NPKS increased tuber yield by 146.8, 163.1 and 197.9 %, respectively. The results indicated that vermicompost (10 t/ha) with NPKS (100%) produced the highest growth and yield of potato. The correlation matrix showed that tuber yield of potato had significant and positive correlation with plant height (r = 0.953**), number of main stem/hill (r = 0.732*), weight of haulm (r = 0.948**), yield of haulm (r = 0.935**), dry weight of haulm (r = 0.935**), number of tubers/hill (r = 0.909**), percentage of dry matter of tubers (r = 0.948**), weight of tubers/hill (r = 1.00***), and dry weight of tuber (r = 0.985**). It is suggested that 100% inorganic fertilizers with 5-10 t/ha of vermicompost is suitable for better production of potato but 10 t/ha of vermicompost may not economically profitable.

Keywords: Potato, Vermicompost, Growth, Yield, NPKS fertilizer, Wastes management

INTRODUCTION

Potato (Solanum tuberosum L.) is a herbaceous leading staple food crops of the world and it ranks next to wheat and rice. In Bangladesh, potato is a first leading vegetable crop and commercially grown in almost whole of the country. The probable place of origin is Peru and Bolivia. It was introduced to the Indian sub-continent during the first half of the 17th century. In Bangladesh, the cultivation of potato was started in the late 19th century but average yield is very low compared to the leading potato growing countries. The major constraint of such low yields viz. lack of quality and available seed tubers, high price of seed tubers, imbalanced fertilizations, no or less use of organic manures and some times low market value at the time of harvesting. Both chemical and organic manures fertilizers can play a major role to improve this situation. Asmus and Gorlitz observed that combined application of FYM and mineral fertilizer increased potato yield. Ilin et al. observed that application of mineral fertilizers and FYM increased tuber yield by 43-45.3%.

Now-a-days gradual deficiencies in soil organic matter and reduced yield of crop are alarming problem in Bangladesh. The cost of inorganic fertilizers is very high and sometimes it is not available in the market for which the farmers fail to apply the inorganic fertilizers to the crop field in optimum time. On the other hand, the organic manure is easily available to...
the farmers and its cost is low compared to that of inorganic fertilizers. The crop production cost is more or less similar with organic and inorganic fertilizer[13], the use of readily available organic sources of nutrients should be used to maximize the economic return. Vermicompost is a good source of different macro and micronutrients particularly NPKS. Use of vermicompost for vegetable production in large scale can solve the problem for disposal of wastes and also solve the lack of organic matter. On the other hand, a judicious combination of organic and inorganic sources of nutrients might be helpful to obtain a good economic return with good soil health for the subsequent crop. Earthworms are one of the important and dominant soil fauna of class Oligochaeta under Annelida phylum and are well known for their contribution to soil formation and wide spread global distributions[22]. Earthworms consume large quantities of organic matter excrete soil as cast and this cast have several enzymes and rich in plant nutrients, beneficial bacteria and mycorrhizae[31]. They also noted that vermicompost is an excellent base for the establishment of beneficial non-symbiotic and symbiotic microbes. Application of vermicompost increases the total microbial population of N-fixing bacteria and actinomycetes. The increased microbial activity improves the availability of soil phosphorous and nitrogen. Vermiculture is the science of rearing of earthworms for mass propagation on organic wastes under semi-natural conditions and vermicomposting is the bioconversion of organic waste materials through earthwormic way[35]. Sensesi et al.[36] mentioned that vermicomposting is a controlled, aerobic, biological process and able to convert biodegradable humus like organic substances and suitable for the application of soil amendment. On the other hand, vermicompost or verminfertilizer is the composting of organic by the action of earthworm into a semi-natural and controlled condition.

Asiegbe and Oikeh[35] found that NPK fertilizers were more efficient than the organic manures in supplying N, P and K at least in the short run, while the organic manure had an advantage in supply of other macro and micro nutrient elements not contained in NPK fertilizer.

Several workers stated that application of N, P, K or organic manure increased yield of potato Adequate information with conclusive evidences on optimum doses of NPKS is limited in Bangladesh condition. Further more, there is no research information about the effect of vermicompost on potato production. Recently, few researches worked on vermicompost[41,33,42,12,2]. Conditions are looking however, information regarding the use of NPKS and vermicompost alone or in combination on the yield of potato. So, the present investigation was under taken to study the effect of vermicompost and NPKS fertilizers on growth, yield and yield components of potato.

MATERIALS AND METHODS

A field experiment was carried out in the Level Barind Soil (AEZ-25) of Bogra during rabi season of November 2001 to February 2002 to study the effect of vermicompost and NPKS fertilizers on growth, yield and yield components of potato (cv. Cardinal). There were 12 treatments viz. T1= Control, T2=Vermicompost (2.5 t/ha), T3= Vermicompost (5.0 t/ha), T4= Vermicompost (10.0 t/ha)+ NPKS (50%), T5= Vermicompost (10.0 t/ha)+ NPKS (50%), T6=vermicompost (2.5 t/ha)+NPKS (100%), T7=Vermicompost (5.0 t/ha) +NPKS (50%), T8= Vermicompost (10.0 t/ha) +NPKS (100%), T9= NPKS (50%) and T10= NPKS (100%). The experiments was laid out in RCB with 3-replications. Soil analysis was done for particle size distribution by Hydrometer method and other parameters by ASI method[17]. The test results showed that the soil was medium fertile with very low content of N & P and pH was 5.4 (Table 1). The land of the experimental field was medium high belonging to the “Level Barind Tract” (AEZ-25). The experimental site was relatively high in elevation compared to surrounding blocks. The doses of N-P-K-S were 90-40-100-18 kg/ha for potato. Whole amount of vermicompost, TSP, gypsum and half of urea & MP were used at plot preparation and remaining urea & MP were applied at 30 days after sowing of carrot seeds. The unit plot size was 2.5cm2 cm. The potato tubers were planted on 20 November 2001. Weeding, irrigation, drainage, crop protection and other intercultural operation were done when necessary. Data on growth, yield and yield contributing parameters were recorded and statistically analyzed with the help of computer package MSTAT-C by Ressel[29] and also tested DMRT. The correlation matrix was analyzed by SPSS program.

RESULTS AND DISCUSSIONS

Plant Height: The plant height was significantly affected by the treatments at different growth period (Table 2). The plant height was progressively increased up to 60 DAS and after that period the growth rate gradually slow. The plant height was recorded after 15 days intervals up to 90 DAP and at harvest of the crop. At 15 DAP, the plant height was significantly influenced by different treatments but there was minimal difference. The plant height at this stage ranges from 5.06 to 9.86 cm. The highest plant height (9.87 cm) was found with vermicompost (10 t/ha) + 50% NPKS (T4) followed by vermicompost
vermicompost (10 t/ha) + 100% NPKS (T_{10}) and the lowest plant height was found in the control treatment. The treatment T_2 is similar with T_3, T_4 & T_{11}; T_3 is similar with T_{12}, T_5 is similar with T_8 & T_9.

At 30 DAP, the plant height was significant in different treatments. The plant height ranged from 13.96 to 22.53 cm. The highest plant height (22.53 cm) was obtained by the application of vermicompost (10 t/ha) + 100% NPKS (T_{10}) followed by vermicompost (10 t/ha) + 50% NPKS (T_4), but T_7 and T_8 are similar. The lowest plant height (13.96 cm) was found in control plot. The treatment T_9 is similar with T_6; T_9 is similar with T_{12}; T_2 is similar with T_3 & T_4.

At 45 DAP, the plant height responded significantly due to the application of treatments. The effects of plant height in this period were more prominent than previous growth period. The plant height varied from 18.40 to 30.30 cm in different treatments. The highest plant height (30.30 cm) was recorded in T_{10} treatment followed by T_6, T_7, T_{12}, T_4 & T_9. The treatment T_9 is similar with T_3, T_2 is similar with T_6 and T_9; T_6 is similar with T_{11}. The lowest plant height was also found in control.

At 60 DAP, The plant height influenced significantly by adding different treatments to the soil. The highest plant height (37.17 cm) was found in T_{10} and followed by T_7, T_3, T_4 & T_{12}. The treatment T_6 is similar with T_{11}. In this stage, 10 t/ha of vermicompost gave the better response than NPKS (100%) at previous period, but at 45 DAP the vermicompost (10 t/ha) and 100% NPKS gave statistically similar plant height.
At 75 DAP, the plant height of potato varied significantly as influenced by different treatments. The plant height varied from 26.80 to 42.86 cm. The highest plant height (42.86 cm) was recorded in T\(_{10}\) followed by T\(_{9}\), T\(_{4}\), T\(_{3}\), & T\(_{1}\). The lowest was in control (T\(_{0}\)). In this stage (from 60 to 75 days) the growth of plant height is gradually increased than previous 15 days. At 90 DAP, the plant height was highly influence in different treated plot. The chemical fertilizers NPKS (100%) with 0, 2.5, 5.0 and 10 t/ha of vermicompost produced the plant height of 40.54, 41.40, 43.33 and 48.53 cm respectively. On the other hand, chemical fertilizers NPKS (50%) with vermicompost (0, 2.5, 5.0 10 t/ha) produced the plant height of 36.57, 36.87, 39.26 & 45.60 cm respectively. The highest plant height (48.53 cm) was obtained by the application of vermicompost (10 t/ha) + NPKS (100%). The lowest plant height (32.80 cm) was found in control treatment.

At the time of harvest, plant height also significantly influenced in different treatments. The plant height ranged from 36.43 to 55.23 cm. The highest plant height (55.23 cm) was found in T\(_{10}\) and followed by T\(_{9}\), T\(_{4}\) & T\(_{3}\). The treatment T\(_{3}\) is similar with T\(_{4}\) and also T\(_{4}\) is similar with T\(_{8}\) & T\(_{12}\). The lowest plant height was found in control treatment. Alam\(^{[12]}\) mentioned that different organic and inorganic fertilizer had significant influences on the yield contributing parameters of carrot. Naher\(^{[27]}\) mentioned that fertilizer management practices had significant effects on the yield and yield contributing characters of potato and maximum plant height (52.0 cm) was recorded when inorganic fertilizer was applied.

The results are in partial agreement with the findings of many researchers in different vegetable crops\(^{[1,2,4,6,9,11,12,14,23,24,25,27]}\).

**Foliage Coverage:** A good foliage coverage indicates its good growth of plants. The area covered by foliage was significantly influenced by different treatments at 30, 45, 60, 75 and 90 DAP (Table 3). The maximum foliage coverage at 30 DAP of 28.30%, at 50 DAP of 42.43%, at 60 DAP of 70.53 %, at 75 DAP of 91.30 % and at 90 DAP of 97.67% by the application of vermicompost (10 t/ha) + NPKS (100%) (T\(_{10}\)). But minimum foliage at 30, 45, 60, 75 and 90 DAP were recorded with 17.27, 28.13, 35.70, 39.27 and 44.03% respectively by the control (T\(_{0}\)). At 90 DAP, the treatment T\(_{10}\), T\(_{4}\) and T\(_{3}\) did not differ significantly. The treatment T\(_{12}\) > T\(_{2}\) but they are statistically similar. The treatment T\(_{11}\) is similar with T\(_{5}\), T\(_{4}\) and T\(_{3}\). Similarly treatment T\(_{8}\) is similar with T\(_{12}\). It was indicated that application of NPKS (100%) performed the similar plant growth as like as vermicompost (5 t/ha) + 50% NPKS (T\(_{8}\)). The foliage coverage increased rapidly up to 60 days and than gradually increased. Naher\(^{[27]}\) showed that the maximum foliage coverage were obtained at 90 DAP by organic or inorganic and their combinations.

**Number of Main Stem per Hill:** The number of main stem per hill was significantly influenced by application of different treatments (Table 4). The number of stem per hill ranged form 2.50 to 3.63. The highest number of main stem per hill produced by the application of vermicompost (10 t/ha)+ NPKS (50% or 100%). The plant having no fertilizer produced the minimum number of main stem per hill. It was also observed that 2.5 and 5.0 t/ha of vermicompost alone and with 50% or 100% NPKS more or less performed similar number of stem per hill. Naher\(^{[27]}\) stated that the maximum number of main stem (3.65) per hill was obtained from organic fertilizer management practices (organic, organic+ inorganic). These finding are partial agreement with the observation of Anand and Krishnapp\(^{[1]}\), who stated that the number of main stem per hill did not increases significantly due to the application of different levels of N and K as well as their interaction. Kushwah\(^{[25]}\) mentioned that the number of stem per plant did not differ markedly under different levels (120, 150 and 180 kg/ha) of nitrogen. Bongkyoon\(^{[27]}\) mentioned that number of stems/plant tended to increase in the plots where 8-10 t/ha vermicompost (EWC) were applied.

**Fresh Weight of Haulm:** The fresh weight of haulm was markedly significant due to the application of different treatments (Table 4). The fresh weight of haulm varied fro 31.67 to 92.33g at harvest. The highest weight of haulm (92.33 g) was found by the application of vermicompost (10 t/ha)+ 100% NPKS (T\(_{10}\)) followed by vermicompost (10 t/ha) + 100% NPKS (T\(_{4}\)) and vermicompost (5 t/ha)+ 50% NPKS (T\(_{3}\)) but T\(_{3}\) is similar with T\(_{8}\). The treatment T\(_{4}\) is similar with T\(_{9}\) and T\(_{8}\) is similar with T\(_{12}\). The application of 2.5, 5.0 and 10 t/ha of vermicompost increased the weight of haulm by 37.0, 40.33 and 54.33 g respectively. On the other hand, application of 50% and 100% of NPKS produced weight of haulm 42.67 and 58.67g respectively. The results are in agreement with the findings of Naher\(^{[27]}\) who stated that the highest fresh weight of haulm (100.788 g/hill) was recorded when inorganic fertilizer managements were applied.

**Percent Dry Matter of Shoot:** There was no significant variation among different treatments in respect of dry matter (%) of shoot (Table 4). The results showed that application of chemical fertilizers (NPKS) increased the dry weight of shoot.
The results are in partial agreement with the findings of Michalik, Anand and Krishnappa and Nahe.

Shoot Yield: The shoot yield of potato was highly influenced due to application different doses of vermicompost and NPKS fertilizers alone and their combinations Table 4). The shoot yield ranged from 1.84 to 5.54 t/ha at harvest. The height shoot yield (5.54 t/ha) was found by the application of vermicompost (10 t/ha) + 100% NPKS (T6) followed by T7 and T9 but T7 and T9 are statistically similar.
The treatment $T_8$ is similar with $T_4$, $T_6$ and $T_{12}$. Similarly $T_9$ is similar with $T_{10}$, $T_4$ and $T_{11}$. The lowest shoot yield (1.84 t/ha) was found in control treatment. The results are in partial agreement with the findings of Michalik[26], Salaman[34] and Alam[1].

**Dry Weight of Shoot:** The dry matter or dry weight (kg/ha) of shoot was significantly influenced by the application of different treatments (Table 4). The dry matter varied from 197.90 to 599.80 kg/ha. The highest dry weight was recorded 599.80 kg/ha by the application of $T_{10}$ treatment and followed by $T_{12}$, $T_6$ & $T_{12}$; $T_9$ with $T_5$; $T_5$ with $T_6$ and $T_5$ & $T_{11}$. The lowest dry weight of shoot was recorded in control pot. The results are in agreement with the findings of Krishnappa[24] who found similar trend in dry matter production in potato plant. Stalin and Enzmann[46] observed that N application increased plant dry matter production and N uptake. Anand and Krishnappa[4] reported that application of N and K increased dry matter accumulation in roots tubers and total plant. Blecharezyk and Skrzypezak[21] found that total dry matter increased with NPK application.

**Number of Tubers per Hill:** The number of tubers per hill was influenced significantly due to the application of different treatments (Table 5). The maximum number of tubers per hill (8.33) was recorded in $T_{10}$ followed by $T_{12}$, $T_6$ & $T_{12}$ but $T_5$, $T_6$ & $T_9$ are statistically similar. The treatment $T_{12}$ is similar with $T_7$; $T_{10}$ is similar with $T_4$ & $T_{11}$. The minimum number of tubers per hill was found in $T_1$ & $T_2$ treatments.

**Percent Dry Matter of Tuber:** Dry matter accumulation in tubers was influenced significantly due to the application of different treatments (Table 5). The maximum dry matter (20.03%) of tuber was found in $T_{10}$ treatment where maximum nutrients were supplied to the plant. The lowest dry matter (18.13%) of tuber was recorded in control treatment ($T_0$). The results are in partial agreement with the reports of Anand and Krishnappa[4], Krishnappa[24], Naher[21], Stalin and Enzmann[46].

**Weight of Tubers per Hill:** The weight of tubers per hill was varied significantly due to the application of different treatments. In the present study, the weight of tubers per hill varied from 146.0 to 426.0g in respect of all treatments. The highest tuber weight per hill (426.0g) was obtained by the application of vermicompost (10 t/ha) + 100% NPKS ($T_{10}$) followed by vermicompost (5 t/ha)+ 100% NPKS ($T_9$) and vermicompost (2.5 t/ha)+ 50% NPKS ($T_7$). The treatment vermicompost (10 t/ha)+ 50% NPKS ($T_7$) produced 314 g per hill, which is statistically similar tuber weight per hill of 318.68g by 100% NPKS ($T_7$). The lowest (146.0g) weight of tubers per hill was found in control.

Bongkyoon[12] mentioned that the application of NPK and vermicompost showed an increment in the average tuber weight per plant. Naher[21] reported that maximum weight of tubers (396 g/hill) was recorded when inorganic fertilizer managements were applied.

**Tuber Yield:** The tuber yield of potato was increased significantly due to the effect of vermicompost and NPKS fertilizers (Table 4). The tuber yield in different treatments ranged from 8.58 to 25.56 t/ha. The height tuber yield was recorded 25.56 t/ha by the application of vermicompost (10 t/ha) + 100% NPKS ($T_{10}$) followed by 22.58 t/ha ($T_7$), 21.18 t/ha ($T_5$), 19.12 t/ha ($T_{12}$) and 18.48 t/ha ($T_9$). It was indicated that 100% NPKS at the rate of 90-45-100-18 kg/ha with vermicompost (10 t/ha) produced the higher tuber yield. But NPKS at the rates of 90-45-100-18 kg/ha with vermicompost (5 or 2.5 t/ha) produced statistically similar tuber yield. Application of 100% NPKS produced the higher tuber yield than 50% NPKS + vermicompost (10 t/ha), but they are statistically similar. On the other hand, 10 t/ha of vermicompost was produced 14.57 t/ha of tuber yield and 50% NPKS (45-22.5-50-9 kg/ha) produced 13.46 t/ha of tuber yield but both are statistically similar. The lowest tuber yield (8.58 t/ha) was found in control.

The relative increase of tuber yield over control has been presented in Figure 1. The different doses of vermicompost (2.5, 5, 10 t/ha) gave 33.1, 48.2 and 69.8% higher yield than control, respectively. Vermicompost at 2.5 and 5 t/ha with 50% of NPKS increased tuber yield over control by 78.3, 96.9 and 119.5 t/ha respectively. And vermicompost at 2.5, 5 and 10 t/ha with 100% of NPKS increased tuber yield by 146.8, 163.1 and 197.9 % respectively. The results showed that 100% NPKS with vermicompost is more efficient that 50% NPKS with vermicompost. The results indicated that 100% inorganic fertilizers with 5-10 t/ha was produced higher yield of potato in Barind soils of Bangladesh. This finding is strongly agreed with the report of Alam[1] in same field.

The present findings are in agreement with many workers[6,9,18,25,39,43,27,10,42,12].

**Dry Weight of Tuber:** The dry weight of potato tuber was calculated from tuber yield and percent dry matter of tuber. The total dry weight of tuber per hectare was calculated out from the per plot data. The present study dry weight of tuber per hectare was influenced significantly by the application of different treatments.
The dry weight (t/ha) as influenced by treatments varied from 1.55 to 5.78 t/ha. The highest dry weight of 5.78 t/ha was obtained with vermicompost (10 t/ha) + 100% NPKS. The lowest dry weight (1.55 t/ha) was found when no fertilizer was added to the soil. Data showed that application of chemical fertilizers (NPKS) at higher dose increased the total dry matter accumulation in potato plants.

The relative increase of tuber dry weight over control has been presented in Figure 1. The vermicompost at 2.5, 5 and 10 t/ha produced 36.7, 54.1 and 79.3% against 1.55 t/ha of control. Application of vermicompost at 2.5, 5 and 10 t/ha with 50% NPKS gave 87.1, 109 and 135.5% and vermicompost with 100% NPKS gave 159.3, 183.8 and 272.9% increased over control. The highest increased of dry weight over control was 272.9% by the application of vermicompost (10 t/ha) + 100% NPKS (T5a) followed by T8 (183.8%), T6 (159.3%), T7 (135.5%) and T5b (134.8%). The maximum increased of dry weight (36.7%) by the application of 2.5 t/ha of vermicompost. The result are in partial agreement with the reports of Krishnappa et al. Stalin and Enzamann, Anand and Krishnappa and Naher.

Table 5: Effect of vermicompost and NPKS fertilizers on yield and yield components of Potato

<table>
<thead>
<tr>
<th>Treatments</th>
<th>No. of tubers / hill</th>
<th>% DM of tubers</th>
<th>Wt. of tubers (g/hill)</th>
<th>Tuber yield (t/ha)</th>
<th>DW of tuber (t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T0 = Control</td>
<td>0.95** 0.72**</td>
<td>18.13 b</td>
<td>8.58 b</td>
<td>1.55 g</td>
<td></td>
</tr>
<tr>
<td>T1 = VC(2.5 t/ha)</td>
<td>6.33 e</td>
<td>18.56 ef</td>
<td>190.33 g</td>
<td>11.42 g</td>
<td>2.12 fg</td>
</tr>
<tr>
<td>T2 = VC(5 t/ha)</td>
<td>6.56 de</td>
<td>18.80 de</td>
<td>212.00 fg</td>
<td>12.72 fg</td>
<td>2.39 ef</td>
</tr>
<tr>
<td>T3 = VC(10 t/ha)</td>
<td>7.43 bc</td>
<td>19.13 bcd</td>
<td>241.67 ef</td>
<td>14.57 ef</td>
<td>2.78 def</td>
</tr>
<tr>
<td>T4 = VC(2.5 t/ha) + NPKS (50%)</td>
<td>6.47 de</td>
<td>18.93 cde</td>
<td>255.00 de</td>
<td>15.30 de</td>
<td>2.90 def</td>
</tr>
<tr>
<td>T5 = VC(5 t/ha) + NPKS (50%)</td>
<td>7.40 bc</td>
<td>19.17 bcd</td>
<td>282.00 d</td>
<td>16.90 d</td>
<td>3.24 cde</td>
</tr>
<tr>
<td>T6 = VC(10 t/ha) + NPKS(50%)</td>
<td>7.97 ab</td>
<td>19.40 bc</td>
<td>314.00 c</td>
<td>18.84 c</td>
<td>3.65 bcd</td>
</tr>
<tr>
<td>T7 = VC(2.5 t/ha) + NPKS (100%)</td>
<td>7.60 abc</td>
<td>19.33 bc</td>
<td>353.00 b</td>
<td>21.18 b</td>
<td>4.02 bc</td>
</tr>
<tr>
<td>T8 = VC(5 t/ha) + NPKS (100%)</td>
<td>7.80 abc</td>
<td>19.50 b</td>
<td>376.33 b</td>
<td>22.58 b</td>
<td>4.40 b</td>
</tr>
<tr>
<td>T9 = VC(10 t/ha) + NPKS (100%)</td>
<td>8.33 a</td>
<td>20.03 a</td>
<td>426.00 a</td>
<td>25.56 a</td>
<td>5.78 a</td>
</tr>
<tr>
<td>T10 = NPKS (50%)</td>
<td>6.60 de</td>
<td>18.80 de</td>
<td>224.33 ef</td>
<td>13.46 ef</td>
<td>2.53 ef</td>
</tr>
<tr>
<td>T11 = NPKS (100%)</td>
<td>7.17 cd</td>
<td>19.03 b-e</td>
<td>318.68 c</td>
<td>19.12 c</td>
<td>3.64 bcd</td>
</tr>
</tbody>
</table>

LSD 0.7172 0.4558 31.63 1.896 0.2302
CV (%) 5.27 1.08 5.11 11.12 12.26

In a column, figures having same letter(s) do not differ significantly by DMRT at the 5 % level.

Table 6: Correlation matrix among different parameters of Potato as influenced by treatments

<table>
<thead>
<tr>
<th>Parameters</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Plant height</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. No. of main stem/hill</td>
<td>0.865**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Wt. of haulm</td>
<td>0.977**</td>
<td>0.829**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Yield of haulm</td>
<td>0.985**</td>
<td>0.850**</td>
<td>0.993**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. DW of haulm</td>
<td>0.976**</td>
<td>0.799**</td>
<td>0.986**</td>
<td>0.986**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. No. of tubers/hill</td>
<td>0.967**</td>
<td>0.927**</td>
<td>0.958**</td>
<td>0.967**</td>
<td>0.929**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. % DM of tubers</td>
<td>0.978**</td>
<td>0.853**</td>
<td>0.951**</td>
<td>0.960**</td>
<td>0.935**</td>
<td>0.959**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Wt. of tubers/hill</td>
<td>0.952**</td>
<td>0.949**</td>
<td>0.936**</td>
<td>0.949**</td>
<td>0.949**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Tuber yield</td>
<td>0.953**</td>
<td>0.732**</td>
<td>0.948**</td>
<td>0.935**</td>
<td>0.935**</td>
<td>0.909**</td>
<td>0.948**</td>
<td>1.00***</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>10. DW of tuber</td>
<td>0.959**</td>
<td>0.729**</td>
<td>0.951**</td>
<td>0.944**</td>
<td>0.945**</td>
<td>0.899**</td>
<td>0.957**</td>
<td>0.985**</td>
<td>0.985**</td>
<td>1.00</td>
</tr>
</tbody>
</table>

NS = Not significant, * = 5% level of significance, ** = 1% level of significance.

Fig. 1: Effect of vermicompost and NPKS fertilizers on percent increase of tuber yield and tuber dry weight of potato over control

Correlation Matrix: In present study, the correlation matrix among different plant parameters have been presented in Table 6. The correlation matrix showed that tuber yield of potato had significant and positive correlation with plant height ($r = 0.953^{**}$), number of main stem/hill ($r = 0.732^*$), weight of haulm ($r = 0.948^{**}$), yield of haulm ($r = 0.935^{**}$), dry weight of haulm ($r = 0.935^{**}$), number of tubers/hill ($r = 0.909^{**}$), percentage of dry matter of tubers ($r = 0.948^{**}$), weight of tubers/hill ($r = 1.00^{***}$) and dry weight of tuber ($r = 0.985^{**}$). This results indicated that tuber yield of potato depends on plant height, number of main stem/hill, weight of haulm, yield of haulm, dry weight of haulm, number of tubers/hill, percentage of dry matter of tubers, weight of tubers/hill and dry weight of tuber. The tuber yield was strongly correlated with weight of tubers/hill.

REFERENCES


