Effect of biofertilizers on horticultural and yield traits in french bean var. Contender under dry temperate conditions of Kinnaur district of Himachal Pradesh

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Abstract: Kinnaur district is known as the dry temperate zone of Himachal Pradesh and is known for off season and quality production of vegetables. In this district of Himachal Pradesh, Natural farming is mostly done with the minimum use of chemical fertilizers. Farmers are unaware of the judicious use of farm yard manure, and biofertilizers due to which yield of the french bean is very low (50-70 q/ha). French bean is one of the most important vegetables intercropped with apple in Kinnaur District. An experiment was conducted during the summer season of 2011 at the Experimental Farm of Vegetable Research Station, Kalpa, Kinnaur, Himachal Pradesh to study the effect of Rhizobium and Phosphorus Solubilizing Bacteria (PSB) on the horticultural and yield traits in french bean var. Contender. Six treatments comprising seed treatments (with and without Rhizobium), seed treatment (with and without PSB) along with the combination of 60 % dose of recommended quantity of Calcium Ammonium Nitrate and 75 % dose of recommended quantity of Single Super Phosphate and organic matter were evaluated in a Randomized Complete Block Design (RCBD) with three replications. The results revealed that T5 treatment, i.e. Rhizobium+ PSB+ Organic matter resulted in more number of pods per plant (20), pod length (18 cm) and pod yield/ha (140 q/ha).

Keywords: Biofertilizers, French Bean, Kinnaur, Pod yield, Yield

INTRODUCTION

French bean (Phaseolus vulgaris L.), a short duration leguminous vegetable crop is known by various names viz., rajma, rajmah, haricot bean, kidney bean, snap bean, navy bean, field bean, dry bean and pole bean. It is grown for its mature dry seeds as well as for immature tender green pods. French bean is a rich source of protein (17.5 to 28.7% in dry seeds, about 1.0 - 2.5% in green pods), carbohydrates (61.4%), mineral content (3.2 - 5.0%), crude fibre (4.2-6.3%), crude fat (1.2-2.0%) and vitamins A and C (Messina, 1999).

Kinnanur district of Himachal Pradesh is situated in North and Northeast part of state representing high hills temperate zone. There is only one cropping season from April-November and no crops can be grown from November-March as the land is covered with snow and area reels under sub-zero temperature. French bean (Phaseolus vulgaris L.) is one of the most important vegetables intercropped with apple in Kinnanur district of Himachal Pradesh. In Kinnanur district, natural farming is mostly practiced with the minimum use of chemical fertilizers and farmers are unaware of the judicious use of farm yard manure and rhizobium inoculation due to which yield of the french bean is low (50-70 q/ha). The Organic manures, apart from supplying macro and micronutrients are also known to improve the physical, chemical and biological properties of the soils (Drinkwater et al., 1995). French bean responds well to organic manures and results in improved quality and sustained production. The modern day intense crop is requires the use of chemical fertilizers, but the prices of inorganic fertilizers have not only increased the cost of crop production but also decreased soil fertility thereby causing environmental pollution.

There is a need to integrate both the use of organics and inorganics for getting the best quality product, which in turn is expected to substantially reduce the cost of cultivation through minimized use of inorganic fertilizers (Tiwari, 2002). It has been revealed from the long term experiments on the fertilizer application that Farm Yard Manure along with the chemical fertilizers results in yield improvement and maintenance of soil fertility (Swarup, 1998). The integrated farming system is an agricultural system conceived so far as to have the least impact on the environment. The use of organic soil amendments has been associated with desirable soil properties including higher plant available water
holding capacity, cation exchange capacity, lower bulk density and can foster beneficial microorganisms (Doran, 1995). Benefits of compost amendments to soil include soil aggregation, pH stabilization and faster infiltration rate due to enhanced soil aggregation (Stamatiadis et al., 1999). French bean is affected by the inadequate availability of nutrients in the soil; it requires a large quantity of phosphorus for optimum growth and yield. To enhance the plants capacity to utilize such nutrients effectively including in the soil, PSB and VAM inoculation have been considered to be effective. Researchers in the few decades established that PSB Treatment could improve plant growth through increased uptake of phosphorus, especially in the soils of low fertility (Ramana et al., 2010; 2011). Organic manures are eco-friendly, cheap source of nutrients and are potentially sound for supplying nutrients which can reduce dependence on chemical fertilizers (Datt et al., 2013). Organic resources are largely biological in origin, and they have several nutrients in their composition, which on decomposition are released into the soil (Kumar et al., 2014). Organic sources of the plant nutrients have been reported to improve nutritional quality, protein content and mineral content in crops as compared to those with inorganic sources (Bhadoria et al., 2002). In recent days, more importance has been given to sustainable agriculture, since the modern agriculture over the last several years depended heavily on chemical fertilizers which are cost intensive and have an adverse effect on soil fertility and the environment. Therefore, there is a need to popularize these environmental safe, ecofriendly and cost effective organic manures. The use of biofertilizers has currently attained a special significance in crop production, and tremendous success has been achieved in several crops. Hence the present study was carried with the integrated use of chemical fertilizers along with farm yard manure, Rhizobium culture and Phosphate solubilizing bacteria in variety Contender of the french bean.

MATERIALS AND METHODS

The present investigations were carried out on French bean variety contender in 2011 at the experimental farm of Vegetable Research Station, Kalpa, Kinnaur (H.P). The experiment was planted in a Randomized Complete Block Design (RCBD) with four replications. Plot size was kept 3x3 m. Five treatments viz., T1: Recommended dose of fertilizers of NPK, T2: 60 % N+ Rhizobium treated seeds, T3: 75% P+ PSB treated seeds , T4: T2+T3 , T5: Rhizobium treated seeds + PSB treated seeds + FYM . All the FYM doses and chemical fertilizers were applied at the time of sowing. Rhizobium culture and PSB culture was applied to the seeds of french bean var. Contender @20 g/kg of seed. The soil was sandy loam having pH 6.4 with organic carbon. The plant height was measured from the lowest cotyledonary node to the growing tip, and the mean of five plants was taken and expressed in centimeters. The number of pods was counted from five randomly selected plans and mean was worked out. The length was measured for all the pods present in the five tagged plants, and average pod length was worked out. Different treatments were also screened for diseases viz., Angular leaf spot and Anthracnose. Disease incidence was calculated on per plant basis by using the following formula:

\[
\text{Disease Incidence (\%) = } \frac{\text{Number of diseased pods}}{\text{Total number of pods x 100}}
\]  

RESULTS AND DISCUSSION

The analysis of variance was carried out for seven characters. The F-value revealed highly significant differences for all the characters viz., Days taken from sowing to marketable maturity, Plant height (cm), Number of pods/plant, Pod length (cm), Pod yield/ha (q/ha), Diseases incidence of Angular leaf spot (%) and Disease incidence of Anthracnose (%). The mean values obtained for these traits have been presented in Table1.

Results revealed that T5 (Rhizobium + PSB + FYM) treatment recorded lowest days (40 days) to marketable maturity. These findings are in line with those reported by Singh et al., (2009). Maximum plant height (48.42 cm) was observed in T1 treatment which was statistically at par with T4 treatment (47.66 cm). Seed inoculation with Rhizobium significantly increased plant height which was also supported by the findings of Rana et al. (2006) and Mfilinge et al. (2014). It can be due to the beneficial effect of seed treatment with

Table 1. Mean performance of five plants of the French bean variety Contender for different horticultural and yield traits.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Days taken from sowing to marketable maturity</th>
<th>Plant height (cm)</th>
<th>No. of pods/plant</th>
<th>Pod length (cm)</th>
<th>Pod yield/ha (Q/ha)</th>
<th>Diseases incidence of Angular leaf spot (%)</th>
<th>Disease incidence of Anthracnose (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>50</td>
<td>40.29</td>
<td>12.90</td>
<td>10.71</td>
<td>80.55</td>
<td>40</td>
<td>38</td>
</tr>
<tr>
<td>T2</td>
<td>45</td>
<td>43.23</td>
<td>12.92</td>
<td>11.51</td>
<td>100.37</td>
<td>25</td>
<td>27</td>
</tr>
<tr>
<td>T3</td>
<td>43</td>
<td>43.04</td>
<td>13.57</td>
<td>10.82</td>
<td>102.88</td>
<td>20</td>
<td>24</td>
</tr>
<tr>
<td>T4</td>
<td>44</td>
<td>47.66</td>
<td>16.57</td>
<td>13.36</td>
<td>120.32</td>
<td>28</td>
<td>20</td>
</tr>
<tr>
<td>T5</td>
<td>40</td>
<td>48.42</td>
<td>20.00</td>
<td>18.00</td>
<td>140.00</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>CDh,ls</td>
<td>2.96</td>
<td>0.750</td>
<td>0.80</td>
<td>1.75</td>
<td>6.57</td>
<td>5.6</td>
<td>4.9</td>
</tr>
</tbody>
</table>

T1: Recommended dose of fertilizers of NPK, T2: 60 % N+ Rhizobium treated seeds, T3: 75% P+ PSB treated seeds , T4: T2+T3 , T5: Rhizobium treated seeds + PSB + FYM
Rhizobium and PSB strains in enhancing the nutrient supply to the plants (Chandra et al., 1987). The highest number of pods per plant (20.00) and maximum pod length (18.00 cm) was also recorded in T5 treatment. Gangwar and Dubey (2012) and Ramanna et al. (2010) also reported similar results and concluded that combined inoculation of Rhizobium and PSB significantly increased the number of pods per plant, seed yield, straw yield, net monetary returns and pod length in cluster bean. T5 treatment also maintained its superiority for pod yield/ha (140 q/ha). Similar results for increase in yield components and seed yield by Rhizobium inoculation was reported by Bindra et al., 2008 and Datt et al. (2013). The maximum number of pods/plant, number of seeds/pods, 100-seed weight, seed yield/plant, crop yield, and protein and oil content were observed when higher levels of P and FYM were supplied. Better results were obtained with Rhizobium + PSB compared to Rhizobium of PSB supplied individually (Ramanna et al., 2010). Yield response can be attributed to increased number of pods per plant and pod length. Seed inoculation resulted in greater yield attributes. This may be attributed to increased nodulation and nitrogen fixation, more solubilisation of natural phosphorus and production of secondary metabolites by the bacteria (Thakur et al., 1998 and Rudresh et al., 2005). Different treatments were also screened for the incidence of Angular leaf spot and Anthracnose under field conditions of vegetable Research Station, Kalpa. Disease incidence of both Angular leaf spot (15 %) and Anthracnose diseases (10 %) was found lowest in T5 treatment (Rhizobium + PSB + organic matter). Rhizobium microorganisms mediate soil processes such as exudation of soluble compounds, storage and releases of nutrients and water, nutrient mobilization and nitrogen fixation, nitrification, denitrification and sulfur reduction (Khan et al., 1999).

Conclusion

The results of the experiment revealed that T5 (Rhizobium + PSB + FYM) treatment recorded lowest days to marketable maturity (40 days) along with maximum plant height (48.42 cm), number of pods per plant (20.00 cm), pod length (18.00 cm) and pod yield per plant (140.00 q/ha). The incidence of Angular leaf spot (15 %) and Anthracnose (10%) was also lowest in T5 treatment which concluded that increased nodulation and nitrogen fixation along with the solubilisation of natural phosphorus and production of secondary metabolites were the main factors which increased the yield and quality of the French bean variety Contender.

REFERENCES


