Development of Farmers Participatory Integrated Nutrient Management Technology in Faba Bean

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Abstract: Faba bean crop production and improvement under unfavorable conditions is the main target for crop growers, breeders and investigators. Sandy and calcareous soils in dry land areas are marginal for crops production in general. The productivity of faba bean crop is low due to technological gaps in adoption of balanced fertilization. For attaining better yield of faba bean the technology (application of NPKS and micronutrients mixture, Fe + Mn +Zn at 60: 38: 40 and 1.0 kg/feddan, one feddan= 0.42ha) was taken from Fertilization Technology Department, National Research Centre, Egypt and tested at farmer fields under Farm Testing program during winter season 2011/2012 at Nubaria district, North West Region of Egypt. After its satisfactory results over local check this technology was demonstrated at farmer fields during winter season 2012/2013. In this way, total of 2700 feddan area was covered in 18 villages with 450 numbers of farmers in two years under this technology. The recommended technology was able to increase plant height (cm), number of branches per plant, pods number per plant, seeds number per plant, 100 seeds weight (g) and straw and seed yield (ton/fed.) over the farmers practice with mean values of 7.2, 20.5, 18.5, 9.1, 17.1, 24.2 and 27.7%, respectively. In addition to improving nitrogen, potassium and micronutrients contents in faba bean straw and seed as compared with farmers practices. With respect to yield quality, protein content of both straw and seed was also increased by 8.3% and 21.0%, respectively. Based on means of two years of data farmers got L.E 3206 of addition return from expending additional cost of L.E 566 with incremental benefit cost ratio of 5.7. This program was effective in changing attitude, skill and knowledge of improved practices of recommended technology including adoption.

Key words: Faba bean - Integrated and balanced fertilization - On farm testing

INTRODUCTION

Faba bean (Vicia faba L.) is one of the most important winter legume crops for human consumption in Egypt as a protein source; generally, it characterized by a relatively high percentage content which varies from 20 to 30. Egyptian Government is pressing hard to increase the yield and quality of faba bean plant through improving agricultural practices such as fertilization to face the increasing demand the population. Many investigators reported that the growth and/or yield of faba bean plant can be improved by application of the macro-element as reported by Bastawisy et al. [1] and Ahmed et al. [2] and micro-element as recorded by Gomaa et al. [3], Abdel-Aal and Ebaid [4] and El-Sayed et al. [5]. In addition, Ziadah et al. [6] reported that plant needs balanced ratios of essential macro and micro nutrients with non deficient and non excess for optimum and economical yield. Therefore, the importance of integrated balance fertilization program which plays an essential role in achieving high yield of crops [7-11]. On the other hand, many researchers have provided the importance of macro-and micro-nutrients particular under limited condition [12-14]. Therefore, it is needed to study the advantages of integrated use of balanced NPK with S and Fe-Mn-Zn mixture in faba bean production under Egyptian soil conditions in order to make Integrated Plant Nutrient Technology feasible, viable and cost effective. For attaining better yield and yield components of faba bean, the present study was therefore undertaken to evaluate the response of Egyptian
faba bean cultivar namely Giza 716 grown in sandy and calcareous soil to an integrated and balanced fertilization program (application of NPKS and micronutrients mixture, Fe + Mn +Zn at 60:37:50:40 and 1.0 kg/feddan) which was taken from Fertilization Technology Department, National Research Centre, Egypt. After its satisfactory results over local check this technology was demonstrated at farmer’s fields.

**MATERIALS AND METHODS**

Improvement of faba bean crop production under marginal and unfavorable sandy and calcareous soils in dry land areas conditions is the main target for crop growers. On farm testing on integrated and balanced fertilization, recommended practice (RP) (application of NPK, S and Fe + Mn + Zn at 60:37:50:40:1.0 kg/feddan, one feddan = 0.42 ha) in faba bean cultivar cv. Giza 716 was conducted at the fields of 36 farmers selected from 18 villages at North West region of Egypt, in total area of 216 feddan with unit area of 6 feddan during winter season of 2011/2012. After its satisfactory results over local check this technology was demonstrated at farmers fields during winter season 2012/2013. For demonstration 450 farmers selected from the same 18 villages. In this way total area of 2700 feddan with unit area of 6 feddan was covered under demonstration. In the demonstration, 18 control plots (farmer practice, FP) were also kept where farmer practices was carried out. The result was compared with the full package of practice. The primary data were collected from the selected farmers with the help of personal interview schedule. Soil sample was taken before cultivation and prepared for physical and chemical analysis according to Black **et al.** [15] as shown in Table 1.

The faba bean seeds were sown on the third week of November in both seasons at the rate of 30 kg/fed. NPK treatment was added as follow, nitrogen fertilization as ammonium nitrate (33.5%N) was applied at the rate of 60 kg N/feddan in three equal doses (21, 45 and 60 days after sowing). Phosphorus as calcium super phosphate (15.5% P$_2$O$_5$) was added at the rate of 37 kg P$_2$O$_5$/ feddan and Sulfur (80% S) at the rate of 50 kg/feddan before sowing. While, potassium as potassium sulfate (50% K$_2$O) was applied at the rate of 50 kg K$_2$O/feddan in three equal dose (21, 45 and 75 days after sowing). The micronutrients treatment (Fe + Mn + Zn mixture) was applied as foliar spray of multi chelated micronutrients compound (3% Fe, 3% Mn and 3% Zn). Plants were sprayed at 30 and 70 days after sowing (at flowering initiation and three weeks later) at the rate of 1.25 g/liter with the rate of 400 liter/feddan. The other different field practices were followed in the usual manner for faba bean production. At the maturity stage, the plants were harvested in the first half of May in both seasons. The data on yield and yield components were recorded. The percent increase in yield was calculated by using formula:

$$\% \text{ Increase in yield} = \frac{\text{Yield of RP} - \text{Yield of FP}}{\text{Yield of FP}} \times 100$$

RP=Recommended practice
FP = Farmers practice

Also potassium and micronutrients contents in faba bean seed and straw were determined according to Chapman and Pratt [16].

**RESULTS AND DISCUSSION**

Data presented in Table 2 indicated that farmers are using low and unbalanced dose of chemical fertilizers as a source of primary nutrients (N, P & K), whereas they are not using any chemical fertilizer for secondary nutrient(S) and micronutrient. Table 2 also shows the percentage gap of application of fertilizers by farmers over recommended practice varied from 25-100%. The values of yield

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Recommended practice(kg/ feddan)</th>
<th>Farmers practice (kg/feddan)</th>
<th>GAP (kg/feddan)</th>
<th>Percent GAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen (N)</td>
<td>60</td>
<td>45</td>
<td>15</td>
<td>33.3%</td>
</tr>
<tr>
<td>Phosphorus (P$_2$O$_5$)</td>
<td>37.5</td>
<td>30</td>
<td>7.5</td>
<td>25%</td>
</tr>
<tr>
<td>Potassium (K$_2$O)</td>
<td>50</td>
<td>0</td>
<td>50</td>
<td>100%</td>
</tr>
<tr>
<td>Sulfur (S)</td>
<td>40</td>
<td>0</td>
<td>40</td>
<td>100%</td>
</tr>
<tr>
<td>Micronutrients (Fe + Mn + Zn)</td>
<td>1.0</td>
<td>0</td>
<td>1.0</td>
<td>100%</td>
</tr>
</tbody>
</table>
attributing characters and yield of the recommended practice were found to be higher over the farmers practice (Tables 3 and 4). The recommended technology was able to increase plant height (cm), number of branches per plant, pods number per plant, seeds number per plant, 100 - seed weight (g) as well as straw and seed yields (ton/feddan) over the farmers practices with mean values of 7.2, 20.5, 18.5, 9.1, 17.1, 24.2 and 27.7%, respectively. In addition to improving nitrogen, potassium and micronutrients contents in faba bean straw and seed compared with farmers practices. With respect to yield quality, protein content of both straw and seeds were also increased by 8.3% and 21.0%, respectively.

The mean values of the two seasons (Table 4) showed that the maximum straw and seed yields (2.5 and 2.26 ton/feddan) were obtained with recommended practices compared to farmer practices (2.0 and 1.77 ton/feddan). These trends might be due to the favorable effect of integrated nutrient management on the proliferation of roots and thereby increasing the uptake of plant nutrients from the soil and ultimately the vegetative growth of plants. These results are in harmony with those obtained by El-Sayed et al. [5]. The increase in the yield attributing characters ultimately resulted in percent increase in the seed yield over farmer’s practices, which was unknowingly relying over unbalanced fertilization. Low or unbalanced fertilizer application is one of the important reasons for low productivity [9].

Data in Tables 5 and 6 indicated that nitrogen, potassium and micronutrients contents in straw and seed were increased due to application of an integrated and balanced fertilization program. It would be cleared the superiority of the recommended practices program in improving potassium and micronutrients contents in wheat straw as compared with farmer’s practices. The key role of integrated balanced fertilization (RP) in increasing plant nutrient contents was due to its favorable effects such as improving some soil chemical properties [17]. Subsequently, apply increments created nutrient balance in the root media, which was a real reflection to their concentration in the plant tissues. These findings are in line with the results reported by Shaaban et al. [8]. Results indicated that nitrogen and potassium contents as an average of the two seasons of RP treatment were 1.3% and 2.4% in straw and 4.1% and 1.5% in seed with a highly increasing percent comparing to FP treatment.
Table 6: Nitrogen, protein and potassium and micronutrients content of faba bean seed as affected by farm and integrated balanced fertilizations.

<table>
<thead>
<tr>
<th>Season</th>
<th>N%</th>
<th>Protein%</th>
<th>K%</th>
<th>Fe (ppm)</th>
<th>Mn (ppm)</th>
<th>Zn (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FP</td>
<td>RP</td>
<td>FP</td>
<td>RP</td>
<td>FP</td>
<td>RP</td>
</tr>
<tr>
<td>2011/2012</td>
<td>3.5</td>
<td>4.0</td>
<td>21.9</td>
<td>25.0</td>
<td>1.3</td>
<td>1.4</td>
</tr>
<tr>
<td>2012/2013</td>
<td>3.3</td>
<td>4.2</td>
<td>20.6</td>
<td>26.3</td>
<td>1.1</td>
<td>1.6</td>
</tr>
<tr>
<td>Mean</td>
<td>3.4</td>
<td>4.1</td>
<td>21.3</td>
<td>25.7</td>
<td>1.2</td>
<td>1.5</td>
</tr>
</tbody>
</table>

FP = Farmer Practice  
RP = Recommended Practice

Table 7: Cost of cultivation, net return and B: C ratio under improved and farmers practice.

<table>
<thead>
<tr>
<th>Season</th>
<th>Average cost of cultivation L.E/feddan</th>
<th>Average gross return L.E/feddan</th>
<th>Additional cost of cultivation L.E/feddan</th>
<th>Additional net return L.E/feddan</th>
<th>Incremental benefit: cost ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FP</td>
<td>RP</td>
<td>FP</td>
<td>RP</td>
<td>FP</td>
</tr>
<tr>
<td>2011/2012</td>
<td>1618</td>
<td>2140</td>
<td>10115</td>
<td>12947</td>
<td>522</td>
</tr>
<tr>
<td>2012/2013</td>
<td>1869</td>
<td>2478</td>
<td>13377</td>
<td>16956</td>
<td>609</td>
</tr>
<tr>
<td>Mean</td>
<td>1744</td>
<td>2309</td>
<td>11746</td>
<td>14952</td>
<td>566</td>
</tr>
</tbody>
</table>

FP = Farmer Practice  
RP = Recommended Practice

Similar trend was observed for micronutrients content, where, the mean values were 208, 20 and 21 ppm in straw and 101, 31 and 25 ppm in seed revealed that the treatment of Integrated and Balanced Fertilization program (RP) produced an improvement results than found in control (FP). With respect to yield quality, protein content of both straw and seed was also increased by 8.3% and 20.7%, respectively. The additional cost of cultivation of L.E cost ratio 522 and 609 gave additional net return of L.E 2832 and 3579 thus, ultimately the incremental benefit 5.4 and 5.9 in both the year winter 2011/2012 and 2012/2013, respectively (Table 7). Based on mean of two years of data farmers got L.E 3206 of addition return from expending additional cost of L.E 566 with incremental benefit cost ratio of 5.7.

**CONCLUSION**

The productivity of faba bean crop continues to be quite low due to technological gaps in adoption of balanced fertilization and other factors also. In addition, prevention of nutrient stress during the growing season ensures optimum crop production and decreases the impacts of adverse environmental conditions. Accordingly, the yield of faba bean can be increased by demonstrating their technologies of balanced fertilization at the farmers’ fields under the supervision of scientists working in the operational area. After obtained good results in On Farm Testing during the year 2011/12, demonstrations on balanced fertilization were conducted in faba bean in a scientific manner at farmers’ fields during the year 2012/2013 and achieved better both yield and its quality. IBF program was effective in changing attitude, skill and knowledge of improved practices of recommended technology (application of NPK, S and Fe + Mn + Zn @ 60: 37:50: 40: 1.0 kg/feddan) including adoption. This also improved relationship between farmers and scientists and built confidence between them. Generally, it can be concluded from this study that highest values of yield and its components and the content from N, K and Fe, Mn, Zn elements could be achieved from Giza 716 faba bean cultivar by application of an Integrated and Balanced Fertilization program into newly reclaimed soils of Egypt which is sandy and calcareous soils. Also, it is suggested that the macro-as soil and micro-nutrients as foliar applications in an integrated and balanced fertilization program has important and effective role in improving faba bean yield and its components.

**REFERENCES**


