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Biozote Performance on Wheat in On-Farm Trials: Farmers' Perceptions

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Abstract: The Biozote application in wheat crop was demonstrated at farmers' fields in Hafizabad and Sheikhupura districts under the project "Improving Soil Fertility and Soil Health in Pakistan". The current study is concerned with the host farmers' perception about the biozote technology as well as its effect on yield and germination of wheat crop in the study area. The data collected showed that the application of biozote along with fertilizers improved the wheat yield to some extent and also helped in germination. According to a few host farmers, it has a positive impact on tillering and also improved the number of florets in wheat crop . It was also noted that the fellow farmer's acceptance of biozote technology was not much satisfactory and they were reluctant to use this new technology, due to ambiguity on its performance. Plant growth was observed much better in the early stage but the yield was average. The fellow farmers were initially convinced after seeing the initial growth but as the yield was almost the same, so they did not take much interest. After the project intervention, only one fellow farmer applied biozote on his own expense in the study area. Although the adoption ratio was not much pleasing, but mostly host farmers were assured that biozote had a good impact on wheat crop especially in germination and, therefore, considered it as a good intervention for the farmers. The host farmers visualized that the main hurdles in adoption were the un-availability of the technology in the local markets and un-awareness of fellow farmers about the technology in the study area.

Key words: Biozote, Wheat, Yield, Farmers perception; Adoption constraints, Pakistan.

INTRODUCTION

In developing countries, the growth of agricultural productivity is considered fundamental for improving the livelihoods of millions of people (Kassie *et al*., 2011; World Bank, 2008). Wheat is the leading food grain of Pakistan and contributes 10% to the value added in agriculture and 2.1% to GDP. The area under wheat has decreased to 9180 thousand hectares in 2014-15 from last year's area of 9199 thousand hectares, which shows a decrease of 0.2%. The production of wheat stood at 25.478 million tonnes during 2014-15, showing a decrease of 1.9% over the last year's production of 25.979 million tonnes (GoP, 2015). However, in Pakistan, production prospects are positive and the wheat output is expected to reach an above-average level. However, dry conditions, during the planting period, have curbed wheat sowings in rainfed producing areas and this is expected to instigate a slight year-by-year production decline in 2017 (FAO, 2017).

Bio-fertilizers are microbial preparations, containing living cells of different microorganisms, which activate plant nutrients in soil from unusable to usable form through biological process (Ismail *et al*., 2014). Naturally grown bio-fertilizers give a better yield as well as non-toxic to human being. Hence, they lead to better sustainable economic development for the farmers and their country (Mishra and Dash, 2014). Bio-fertilizers are becoming popular in different countries of the world for many crops as they contain active or dormant strains of soil microorganisms, either bacteria alone or in combination with algae or fungi that increase the plant availability and uptake of mineral nutrients (Vessey, 2003). Bio-fertilizers play a vital role in improving soil fertility by fixing atmospheric nitrogen. They increase solubility of insoluble soil phosphates and produce plant growth substances in the soil (Venkatashwarlu, 2008). Bio-fertilizers release growth-promoting substances, which increase crop yield by 10-50% as well as improve soil tilth (Mostara *et al*., 1995). In Pakistan, bio-fertilizers are manufactured and sold commercially by different research organizations. Biozote is manufactured by Pakistan Agricultural Research Council (PARC), Islamabad, and it is composed of living bacteria TAL-169 in the carrier material. Application of phosphorus to legume crops improves grain yield considerably (Hussain *et al*., 1981). In chickpea, grain yield was increased considerably with Rhizobium and

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phosphorus application (Raut and Koh ire, 1991). *Rhizobium inoculum* generally increased plant growth, yield and yield components and nitrogen fixation in chickpea (Fatima *et al.,* 2008). T he chemical fertilizers are applied in huge amounts to meet the nutrient requirement and due to high energy prices in Pakistan, it beco mes very costly. The excessive use of chemical fertilizers causes environmental pollution and slows down the growth of beneficial microbes in the soils. For healthy ecosystem, the use of organic fertilizers and microbial materials (bio-fertilizers) is important and viable.

Land Resources Research Institute of NARC/PARC had developed biozote for legumes and cereals and the results showed 20-40% increase in yields. Biozote formulations contain diverse groups of microorganisms, which can fix atmospheric nitrogen, solubilize applied fixed and i nherent soil phosphorus and secrete plant growth promoting hormones, i.e., indole acetic acid (IAA) and gibberellic acid (GA). After 15 years of research efforts, the Soil Biology and Biochemistry Program of Land Resources Research Institute, NARC, Islamabad, produced biofertilizer with t he name "Biozote-Max" for different types of crops (wheat, rice, co tton, sugarcane, maize, sunflower and canola).

The main objective of the stud y was to identify the host farmer's perception about the biozote impact on yield and germination of wheat crop as well as the barriers in the adoption of the biozote technology in the study area.

MATERIALS AND METHODS

The present study was carried out in district Hafizabad and Sheikhupura of Punjab, Pakistan. The five demonstration sites were conducted by Land Resources Research Institute, NARC, during Rabi season (Winter) 2014-15, under soil fertility and soil health project. Each demonstration site consisted of two plots (experimental plot an d controlled plot) of area one acre each with and wit hout biozote technology. The application ratio of biozote was two packets (1 kg) per acre and the experiments were conducted under fully irrigated conditions and equal size of DAP and SOP were used in both experimental and controlled plots. On the basis of objectives of the study, a pre-tested interview schedule was developed that was mainly targeted to reco rd the farmers' perceptions about the ef fect of bi ozote on plant growth and yield. The data were analyzed, using Microsoft excel and simple descriptive statistics to determine the factors, affecting farmers' adoption of the specific technology and for assessing the impact of the technology on crop productivity. Similarly, the socio-economic status of the host respondents was calculated on the basis of age, educational level, size of land holding, involvement in farming, irrigation sources and water lifting devices in the study area.

RESULTS AND DISCUSSION

This study provides an insight of socioeconomic and demographic profile of the host farmers beside presenting the res ults of the determinants of ho st farmers perceptions and adoption of the technology and its impacts on the yield in study area. Socioeconomic status refers to a finely graded hierarchy of social positions, which can be used to describe a person's overall social position or standing. It can be indicated by a nu mber of c oncepts such as employment status, occupational status, educational attainment, income and wealth (Graetz, 1995).

Socio-economic status of the host farmers: Age refers to the chronological age of t he respondents in years at the time of interview; education refers to the level of formal education obtained by the respondents, while land holding refers to the possession of land in acres by the resp ondents. It is evident from Table 1, that the mean of age, average formal education, farming experience and average cultivated land of the host farmers were 49 years, 9 years, 18 years and 97 acres, respectively. The majority of respondents (40%) was in the old age group, i.e., 51 years and above, whereas, middle age respondents (40%) were falling in age group i n the range of 31-50 years and the young age (up to 30 years) were 20% only. Thus, it can be inferred that the host farmers were mainly old and middle aged, were i n their economically active stage and could undergo the stress. It is obvious that none of the respondents was illiterate in host farmers. Among literate r espondents, the educational level was recorded in descending order as primary (20%), middle (40%), matriculate (20%) and graduate (20%). Thus, most of t he host far mers had middle level education, which is essential for farmers to know how to seek for and apply information on improved farm practices. The land h olding of the families to which the respondents belonged was observed and described on t he basis of 3 main categories, viz. small, medium and large. It is clearly indicated that a majority of the respondents (60%) was observed in the landholding category of medium range (50-100 acres), followed by respondents (20%) in category of small (below 50 acres) and 20% of respondents were observed in the large category (100 acres and above) of land holding.

Table 1: Distribution of respondents according to age, education and land holding.

Particulars	Categories	Respondents % (f)	Mean
Age (years)	up to 30 (young)	20 (1)	**49**
	31-50 (middle)	40 (2)	
	51 and above (old)	40 (2)	
Formal education (years)	Primary	20 (1)	**09**
	Middle	40 (2)	
	High	20 (1)	
	Graduate	20 (1)	
Farming experience (years)	0-10	20 (1)	**18**
	11-20	40 (2)	
	21-30	40 (2)	
Total cultivated land (acres)	Below 50 acres	20 (1)	**97**
	50-100 acres	60 (3)	
	Above 100 acres	20 (1)	

Source: Survey data, 2014-15.

Host farmers' involvement in farming, irrigation source and water lifting device: Table 2 presents the full time and part time involvement of the host respondents in farming, their irrigation sources as well as water lifting devices, used for irrigation purposes. The data in Table 2 shows that all the host farmers were fully involved in farming activities, while 20% of the host farmers were using tubewell, while 80% were using both (tubewell + canal) for irrigation purposes. For water lifting device 40% farmers were using electric motors, while 60% were using both (electric motor + peter) in the study area.

Table 2: Involvement in farming, irrigation source and water lifting device.

Particulars	Categories	Respondents % (f)
Involvement in farming	Part time	**00 (0)**
	Full time	**100 (5)**
Irrigation source	Tubewell	**20 (1)**
	Tubewell + Canal	**80 (4)**
Water lifting device	Electric motor	**40 (2)**
	Electric motor + Peter	**60 (3)**

Source: Survey data, 2014-15.

General perception of the host farmers about biozote technology: The data in Table 3 presents the general observations of the host respondents about the biozote performance and impact on crop stand and vigor as well as on germination. It is evident from Table 3 that 60% of the host respondents observed it merely good, while 40% found it as low in performance. The observations, regarding crop stand and vigor, were slightly encouraging and 40% of respondents were convinced that biozote also performed good and 60% evaluated it as low in performance. Similarly, 20% of the host respondents were not satisfied about the biozote performance in germination, while the remaining host farmers observed 5 to 20% improvement in germination of wheat crop with biozote in the study area. The observation, regarding effect on yield, was a bit encouraging and 40% respondents observed no change, while 60% of the host respondents observed 1-3 mounds increase per acre in the study area.

Table 3: General observations of the host farmers about biozote performance:

Particulars	Categories	Respondents % (f)
Overall perceptions regarding biozote performance	Very good	00 (0)
	Good	60 (3)
	Low	40 (2)
Observations regarding crop stand and vigor	Very good	00 (0)
	Good	40 (2)
	Low	60 (3)
Biozote performance in germination of wheat	00%	20 (1)
	05%	60 (3)
	10%	20 (1)
Effect of biozote on wheat yield (per acre)	No change	40 (2)
	1-3 mounds	60 (3)
	4-6 mounds	00 (0)

Source: Survey data, 2014-15.

Other aspects of biozote technology: Technology is very important in agriculture production. The information about the key benefits from biozote by the respondents is given in Table 4. The data in Table 4 shows that 40% of respondents assessed yield as a major benefit, 20% observed fertilizer saving, while 40% found both (yield + fertilizer saving) as a major benefit. The biozote adoption ratio was still not satisfactory in the study area as only one fellow from farmers adopted biozote on his own cost after the project intervention. Similarly, the majority (40%) of the host farmers found lacking of awareness, 40% reported un-availability of the biozote in local markets and 20% observed other aspects like no involvement of local dealers and others fertilizers practices in the study area as a major hurdle in adoption.

Table 4: Other aspects of biozote technology.

Particulars	Categories	Respondents % (f)
Major benefits which farmers perceive from biozote technology	Yield	40 (2)
	Fertilizer savings	20 (1)
	Both	40 (2)
Fellow farmers acceptance of biozote technology	High	00 (0)
	Medium	20 (1)
	Low	60 (3)
	No interest at all	20 (1)
Any farmer in your area used biozote at his own looking after the project intervention	Yes	20 (1)
	No	80 (4)
Major problems in adoption of biozote technology in the study area	Availability	40 (1)
	Awareness	40 (2)
	High cost	00 (0)
	Others	20 (2)

Source: Survey data, 2014-15.

CONCLUSION AND RECOMMENDATIONS

Adoption of new technology is very crucial for agriculture productivity and development. The application and use of bio-fertilizer will not only have an impact on yield but it also contributes to a sustainable ecosystem. The present study was conducted to evaluate the host farmers' perceptions for sustainability of biozote technology demonstrated by LRRI, NARC, at Sheikhupura and Hafizabad districts under the project of soil fertility and soil health. The results of the current study showed that all the host respondents were fully involved in farming

activities and 60% observed the biozote technology as good, while 40% assessed it low in performance. Similarly, the results about the crop stand and vigor showed that, 40% of the host respondents assessed it good, while 60% host farmers were not much hopeful about its impact on crop stand and vigor. Therefore, to spread the adoption of biozote in the study area, there is a need to create more awareness in fellow farmers. It is also necessary to spread the information, regarding this technology and its use, through organizing more practical Farmer Field Days (FFDs) and training programmes. The site selection of demonstrated plots was good but permanent display boards of the specific technology must be arranged at demonstration sites. This will be helpful in knowledge enhancement about the technology in fellow farmers in the study area. The local dealers are an imperative observable fact in the study area, so their involvement may play a key role in adoption and wider dissemination of biozote technology. For commercializing this technology on larger scale, the host farmers suggested that ASPs, local representative and other institutes like extension departments, etc., can be engaged in commercialization of biozote.

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