PATTERNS AND LIMITATIONS OF MICRONUTRIENTS APPLICATION FOR CITRUS PRODUCTION IN SARGODHA: A CHALLENGE FOR EXTENSION EDUCATION IN THE PUNJAB

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ABSTRACT

A study was conducted in the Institute of Agriculture Extension and Rural Development, University of Agriculture, Faisalabad during 2012 to assess the citrus growers concern regarding adoption of micronutrients recommendation for vigorous growth of citrus in Sargodha. Multistage sampling technique was used to select 120 respondents for this study. A well structured interview schedule was used to collect information on variables such as socio-economic characteristics, awareness and adoption of micronutrients and problems militating against adoption of micronutrients. The results revealed that most of the respondents were of middle aged, with land holding size of 5–10 acres. However, 71 percent respondents were found to have formal education of different levels with prominent category of primary to middle level education. Awareness regarding micronutrients utilization was found very poor as just Zn was known to 57 percent respondents and knowledge about rest of the micronutrients was below the mark. Adoption of micronutrients was found extremely poor as maximum adoption of Zn was retrieved by 5.83 percent growers and rest of the micronutrients were not being used. The results further revealed that manual application was being adopted instead of foliar application. This non-adoption includes top factors responsible for harvesting production of half than the potential. Inadequate technical knowledge, shortage of finance, inadequate market, and adulteration of chemicals and interest of citrus growers are the most important constraints scoring mean values i.e. 4.37, 4.21, 3.99, 3.91 and 3.01, respectively. It is suggested that citrus growers should be trained by extension field staff to improve technical knowledge. Moreover, along with subsidy on inputs, special attention should be paid toward awareness dissemination of micronutrients application. Adoption of these chemicals is necessary to boost the production level of leading fruit to compete the developing and developed countries of the world.

KEYWORD: Micronutrients; extension education; multistage sampling; awareness; adoption; citrus production; Pakistan.

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INTRODUCTION

Citrus is a leading fruit of Pakistan, which is grown almost in entire country as the prevailing climatic conditions of country are viable for citrus cultivation (24). Within the country Punjab province is prominent regarding production and foreign exchange earnings through citrus export. Sargodha, Jhang, Sahiwal, Multan, Mianwali, Rahim Yar Khan and Toba Tek Singh are known as the major citrus growing areas in the Punjab province. However, Sargodha is leading district in citrus production and export as well (2). Various cultivars and varieties are being cultivated in country but Kinnow cultivar is of key importance making Pakistan the largest Kinnow producer (3). However, per hectare production of citrus is lower than the potential. Average citrus production of the country is 9.5 tons per hectare against the potential of 18-20 tons per hectare (2). This low production is attributed to various reasons identified by various researchers. These reasons are widespread to socio economic conditions of farmers, research status, technology transfer activities and extension field work. Likelihood of poor adoption of improved practices also intensifies the constraints.

Gangwar *et al*. (7) documented finance shortage as more dominant factor responsible for lower production. They justified the statement mentioning farmers' misery to remain unable to purchase the essential inputs at application time. This uncertain situation cause production gap due to inadequate management and non-adoption improved production practices. Tariq *et al.* (26) described adoption of poor management practices like inadequate fertilizer and nutrients management plights responsible for lower production of citrus. Mattos *et al*. (15) highlighted nutrients deficiency in Pakistani citrus orchards pertinent to inappropriate supply of micronutrients; essential for the bearing and non-bearing trees.

Soil is a natural resource primary to farming and nutritional status of soil does matter in production process. Soil nutritional status has been reported as a significant problem in the past by Quaggio *et al.* (17). Excessive or non-judicious utilization of fertilizer may be held responsible for dwindling soil nutritional status. Khanna *et al.* (9) were of the view that variation in soil nutritional condition becomes the cause of low production in citrus particularly. Similar findings were stated by Sing *et al.* (24) that decreasing soil fertility and inadequate management of plant nutrients have made production rehabilitation more difficult. Moreover, in-balanced application of fertilizer and micronutrients is a major top reason for declining productivity.

In addition to fertilizers application, micronutrients are also anticipated as essential for sound plant growth. Soil in Pakistan is commonly found deficient in multiple nutrients including N, P, Fe, Mn and Zn. Therefore traditional application of nutrients management strategies has not been found much successful. In this context, application of micronutrients is assumed as better strategy. Small amount of micronutrient is required as compared to those of primary nutrients, yet these are equally important for plant metabolism (10). Deficiency of these nutrients can occur because of numerous unfavourable operations i.e. Zn deficiency may occur by heavy phosphate application and excessive use of Fe, Cu and Zn in soil while excessive liming persuade Cu deficiency (13). Farmers utilize excessive nitrogenous fertilizers to get maximum production that cause soil degradation hindering nutrients availability causing nutrients deficiency (5). Catara (6) had reported that farmers do not apply nutrients according to requirement and recommendation, resultantly citrus plants face physiological disorders.

Citrus production can be doubled in Pakistan with little management and concern of growers. The present study was conducted to explore patterns and to explore limitation of micronutrients application and the challenges to extension field staff to document the progress.

MATERIALS AND METHODS

The study was conducted in the Institute of Agricultural Extension and Rural Development, University of Agriculture, Faisalabad, Pakistan during the year 2012. The study was based upon cross sectional research design and simple random sampling technique was adopted for the selection of sample size because population was homogenous. In addition, sampling frame consisting of list of growers was also obtained from the District Officer, Agriculture, Sargodha. The study area comprises total 24 union councils (22 rural and 2 urban). From the rural union councils five were selected randomly. From each selected union council two villages were selected at random and from each selected village 12 citrus growers were selected by simple random sampling technique making a sample size of 120 respondents. Interview schedule was prepared as research instrument comprising questions regarding demographic characteristics of farmers, awareness regarding micronutrients and their mode of application. In addition, growers' constraints regarding awareness and adoption of micronutrients application were also evaluated. Key informants interviews were also conducted to assess the farmers' perceptions regarding role of extension field staff in study area. Data were collected through face to face interviews and observation technique.

The data were analyzed using computer software Statistical Package for Social Sciences (SPSS). Descriptive statistics (frequency, percentage, mean and standard deviation) were used to make the data meaningful. Content analysis of data collected through qualitative discussion with key informants was undertaken. Five point likert scale (1=very low, 2=low, 3=medium, 4=high, 5=v high) was used to rate the constraints. Constraints were rated as most important and less important on the base of average mean of 5 point likert scale i.e. 1+2+3+4+5= 15 with average of 15÷5 = 3.

Constraints having mean value above 3: were considered as most important
Constraints having mean value less than 3: were considered as less important

RESULTS AND DISCUSSION

1. Demographic characteristics

The data (Table 1) showed that almost half of the respondents (48.4%) belong to middle age category. The results also showed that majority of the citrus growers (75.8%) received some level of formal education while remaining (24.2%) had no formal education.

Table 1. Distribution of respondents by demographic characteristics (n = 120).

Demographics		Frequency
Age (Year)	Young (<35)	46 (38.3)*
	Middle (35-50)	58(48.4)
	Old (> 50)	16(13.3)
Educational Level	Illitrate	29(24.2)
	Up to primary	23(19.2)
	Primary to middle	36(30)
	Middle to matric	17(14.1)
	Above matric	15(12.5)
Size of land holding (acre)	< 5	47(39.1)
	5-10	39(32.5)
	> 10	34(28.3)

** values in the parenthesis are percentages*

This indicates the relative high literacy level of the area. This might help the farmers in faster adoption of improved citrus production practices and also can help extension work. Regarding issue of land holding size, reasonable size of farmers (39.1%) had less than upto 5 acre land holdings followed by

32.5 percent farmers having 5-10 acres. Most of the respondents belonging to these categories had maximum cultivation of citrus fruit on their lands.

The data Fig. 1. Revealed that most of the farmers had knowledge about the micronutrients usage. Zn appeared as the most known micronutrient as compared to other micronutrients but overall farmers were less concerned about. This less concern was unfortunate indicating that farmers were unaware of the worth of these micronutrient for citrus. Zn and Mn work as bridge in plant to create interconnectivity between enzyme and substrate where it is intented to do work (18). Tariq *et al.* (26) reported that micronutrients application leads to more number of fruits and boost production as well. Ghosh and Basra (8) also narrated that combined application of micronutrients with NPK help in acquisition of maximum number of fruits per plant.

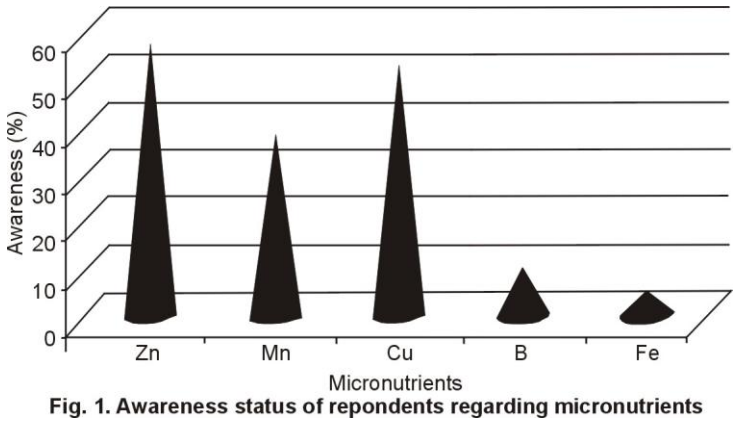

Fig. 1. Awareness status of repondents regarding micronutrients

Moreover, Cu was also found prominent after Zn awareness. Same lesser concern of farmers about Zn was identified by Bala *et al*. (5). During informal discusion with the farmers. it was perceived that pesticide companies agents pay frequent visits to prmote the recommendations of micronutrints. Also farmers were found more inclined towards private sector work than public sector interventions.

3. Awareness and adoption of micronutrients recommendations.

Agricultural expers recommend particular conentrations and doses for a particular plant or crop keepig in mind its requiremnt. Likewise, experts recommend few recommended doses of micronutrients for the citrus to get maximum productivity. When farmers were inquired about their familiarity

about micronutrients recommendation for citrus plants, familiarity of Zn @ 0.2 kg per plant appeared more prominent (26.6%) followed by Mn @ 0.1 kg per plant (11.6%). Similar fashion was observed in context of adoption, however, adoption was substantial. Awarenss and adoption of other micronutrints i.e. Cu, B and Fe was almost negligible. These findings generally indicated to awareenss and adoption gap and extension field staff could be considered as responsible for the existing gap.

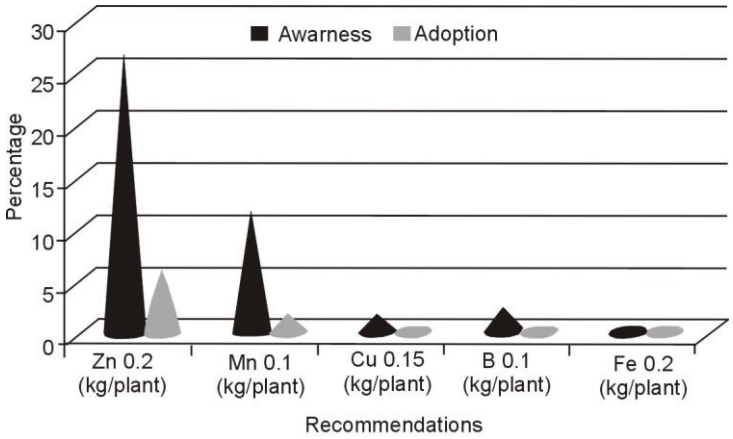

Fig. 2. Awareness and adoption status of respondents regarding micronutrients applications

Among micronutrients only Zn and Mn were being practiced in study area.No wonder, Zn is worthwhile element in the light of better fruit quality development by fruit drop reduction (14) and granulation reduction Kaur *et al.* (11). Its limited adaptibility is a source of restlessnes. It appeared from the informal conversation that farmers were using micronutrients, but priority was their own will, feasibility, resources availability and estimation rather than recommendations prescribed by extension field staff.

Few growers also showed stereotype behavior denying the importance of micronutriensts for plants. Growers just rated micronutrients as source of earning for fertlizer and pesticide agencies. Farmers further narrated that these micronutrients didn't had any beneficial impact on plant health and fruit quality because of impurities involved, hindering farmers intentions and interests towards adoption. In this context,technically existing gap is needed to be minimized indeed because mineral nutrition is a major factor in maximizing yield of high quality fruit, it is essential to understand the functions of mineral elements, diagnose nutrient deficiencies, and provide

required fertilizers in sufficient amounts to the plants (2). Same adoption gap regarding Zn as compared to other micronutrients such as Cu, B and Fe etc. was reported by Saifullah *et al.* (20).

Generally two types of methods were observed in study area named as manual application and foliar application. Because of easiness, manual application method was most familiar among farmers (40%). Foliar application is assumed as technical therefore, its awareness was about 14.6 percent. Sajid *et al.* (21) found that foliar application of Zn with B enhanced the production and to minimized the citrus decline. Moreover, B defeciency in citrus cause extented fruit abortion (19) while Zn defecincy reduce leaves elongation (26). Keeping in mind these supportive findings, it can be said that farmers need to change their intentions and must have to embrace the adoption for their well being. In this regard, public sector extension also needs to impart training to the farmers at their farm regarding micronutrients importance and their timely application.

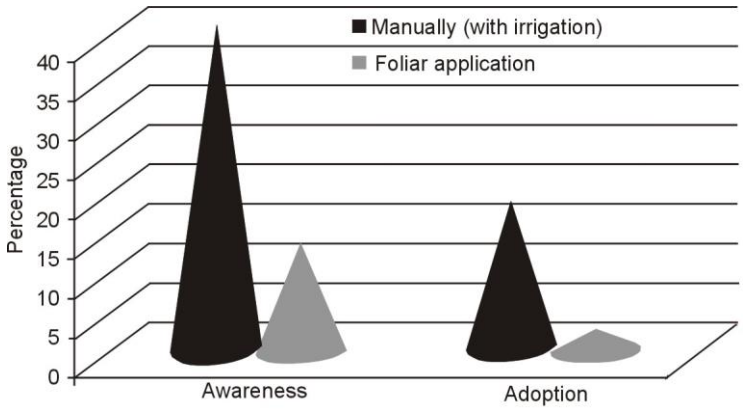

Fig. 3. Awareness and adoption of farmers regarding mode of application.

In the context of adoption one fifth respondents were adopting manual application who were either adopting according to the recommendations or adopting at their own will. Only 2.5 percent respondents were having adoption of foliar application in their orchards. All these adopters were progressive farmers and they were having ability to bear the expenses of huge labour to perform this task in their orchards.

Use of micronutrients in study area

A dilema observed in the study area was that the growers were followers of estimation instead of recommendations as these growers were using micronutients alongwith other nutreints in the form of mixture. For instance,

discussion with progressive farmers revealed their usage pattern of B and S. They use B and S just for kinnow cultivar along with Ca and Mg to make the skin vigorous. Cu and S were being utilized also to strengthen the skin of plant which also hleps in killing the nematodes living in the plant rootes. Cu was monthly being used because it is common and accessable in market easily. When farmers were enquired about the information media for this usage pattern they depicted the pesticide agents their primary source suppressing the role of public sector extension (EFS).

Constraints to the adoption of micronutrients

Farmers were inquired to probe the sevral constrainst militating their adoption level. In this regard their responses towards different constraints were identified which are ranked according to the mean values (Fig. 4).

Table 2. Constrainst to the awareness and adoption of micronutrients.

Problems related to	Mean	S.D	Rank
Technical knowledge	4.37*	0.87	1
Finance shortage	4.21*	1.00	2
Inadequate Market	4.21*	1.11	4
Adulteration of chemicals	3.99*	1.34	5
High costs of inputs	3.91*	1.25	3
Interest of citrus growers	3.01*	1.70	6
Inadequate education	2.70	0.60	7
Skilled labour	2.11	0.51	8
Cooperation of EFS	1.33	0.66	9

*Most important

Farmers were lacking in technical knowledge therefore they were so far away from the adoption of technicalities and recommended practices. Similar results were reported by Bala *et al.* (5) observing that inadequate technical knowledge regarding micro-nutrients, fertilizer and pesticide application was the major hurdle in the adoption of improved production practices. As discussed in demographic portion, majority of the farmers were small farmers with financial instability. For these small landholders it was not easy to afford the high prices of inputs. In this perspective, these farmers stated finance shortage and high costs of inputs as major problems. These findings are similar to those of Badal and Singh (4) where literacy level of growers, cooperation of extension staff and access to finance were identified as momentous factors manipulating the behavior of farmers towards adoption. Poor marketing and inadequate market infrastructure was found as constraint to adoption. These results are supported by Bala *et al.* (5) who found that

poor infrastructure of market was militating factor in adoption. Adulteration of chemicals was considered as dominant problem because of its immense existence. It can be said that on behalf of this severe adulteration, farmers were compelled to declare micronutrients having no worth. Last but not least, carelessness on the part of growers was also exhibited as constraint. This carelessness was of multidimensional which could be related to information acquisition from extension field staff (EFS) or undertaking timely operation at the farm. Most of respondents were somewhat happy with role of extension field staff that's why extension field staff cooperation remained at least level.

Farmers perceptions about role of EFS

Discussions were held with key informants and qualitative content analysis showed a blend of support and flaws of EFS. Few of the respondents showed consensus that EFS are working good within their strategic framework and resources. Few of respondents claimed discrimination in EFS advisory services. These farmers argued that extension field staff just visits the progressive farmers and completely ignores the small landholders or farmers with limited resources. During informal discussion one of the respondents stated

"*Let the extension agents do their work, they have no concern with us so neither we have*".

General outlook of discussion showed that farmers have trust on the extension field staff and also wait for their effective work. In this context farmers suggested the frequent visits of EFS, extended cooperation, improved techniques of technology transfers and facilitation for the farmers without any discrimination.

CONCLUSION

The productivity of citrus continues to be low due to existing technological adoption gaps among farmers. Among the existing gaps micronutrients adoption gap has been observed in this study. Micronutrients are necessary elements for better citrus productivity can be increased by demonstrating technologies relevant to balanced fertilization in orchards under the supervision of extension agents the areas. The study further concludes that awareness of micronutrients and their application is below the mark. Only Zn and Mn were found familiar which is not enough for better production. Farmers were more inclined towards traditional manual application which

may reduce the efficiency. Growers were using traditional micronutrients without following recommendations. Moreover, role of EFS was rated as substantially good. Farmers were facing constraints like inadequate technical knowledge, finance shortage, inadequate marketing and adulteration of chemicals and high cost of inputs. Study recommends that EFS should promote and convince citrus growers to apply micronutrients in their orchards according to recommended doses. Moreover, extension field staff should diversify their roles. Demonstration methods should be utilized for better comprehension of farmers. Also public sector should launch some micro credit schemes to overcome the existing finance shortage problems and high input costs. This support will not only boost the interest of growers but also adoption level will be increased.

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