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An overview of insect-pest and diseases management in rice crop for outreach interventions

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Abstract

Rice (*Oryza sativa* L.) is feeding more than half of the world's population. It is cultivated in almost 114 developing countries for food, income and employment generation. Ninety percent share of rice production is contributed by the Asian countries including Pakistan where rice production is continuously dwindling subject topoor insect pest and diseases management. This study is an effort to underpin an overview of insect-pest and diseases management in rice crop and document feasible outreach solutions for the revival of rice production in the country. For the in-depth analysis, a sample of 342 rice growers was drawn from 2,365 registered rice growers. Data were collected through validated interview schedule followed by observations and focus group discussions techniques. Findings of the research summarized that chemical management of insects' pests and diseases of the rice crop was most preferred mode despite excessive application of chemicals is endangering the environment. Conversely, biological control which is environmentally friendly was perceived poorly preferred mode by the respondents. Findings stressed on the persistence of wide information gapamong farming communities regarding environmental safety which is direly needed to be overcome through diversified outreach services by public and private sector with the collaboration of research and extension. This holistic collaboration could pave the way toward sustainable farming supportive to a safe environment.

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Introduction

Rice (O*ryza sativa*L.)is the largest staple food as well as the most cultivated cereal after wheat in the world. Two-thirds of global impoverished population lives in Asia and intakes 80 percent of the daily calories from rice. It provides 21 and 15 percent of global human per capita energy and protein, respectively. In addition to dietary energy (1527 KJ/100g) and protein (7.9 g/100g), itis a rich source of minerals (K, Ca, P, Fe, Zn), amino acids and vitamins (thiamine, riboflavin, niacin) which protect the human being against neural sickness and ensures healthy growth during pregnancy and childhood. It is very useful against anemic diseases due to its iron contents (1.5mg/100g) (Zeigler, 2006; USDA, 2014). It adds 3.1 percent value in agricultural commodities and contribute 0.9 percent in economy of Pakistan. Rice industry absorbs 9 percent of the national labour force. It also shares on an average 2 billion national foreign exchange exchequers annually along-with bilateral trade with other countries (Govt. of Pak., 2015). According to Trade Development Authority of Pakistan (2014) rice trade is one of the main reasons behind the close ties of Saudi Arabia, United Arab Emirates, Iran and Sri Lanka with Pakistan.

Pakistan is the 11th largest rice producer in the world. Almost 6 million tons of rice is produced annually. It adds two million tons in national food requirements. There was 2.3 million hectare (1.05 Basmati, 0.58 IRRI, 0.66 others) area under rice cultivation and 5.5 million tons production (1.86 Basmati, 1.82 IRRI, 1.85 others) with 1.7 tons per hectare during 2013 which is 10 percent less than previous year (Pak. Bureau of Statistics, 2014).

The Punjab is the leading province in rice cultivation with 0.99 million hectare under rice crop and 3.4 million tons production annually. It is more than 70 percent of total national rice cultivation and production. The contribution of the Punjab in production of fine rice is also very significant. Gujranwala is the predominant district out of 36 districts of the province regarding rice cultivation and production. The crop is cultivated on an area of about 0.25 million hectares with a production of 0.55 million tons (Crop Reporting Service, 2014).

Various agricultural research institutions are working to improve the rice quality and its cultivation.Main emphasis of Pakistan Agricultural Research Council (PARC) and Nuclear Institute of Agriculture and Biology (NIAB) is on genetic modification as well as reduction of phytic acid by mutation and hybridization for high quality rice germplasm. They are also endeavoring on disease (Bacterial Leaf Blight), cold and salt tolerance of rice (Nat. Inst. Agri. Biotechnology, 2015; Pak. Agri. Res. Council, 2008). Rice Research Institute, Kala Shah Kakuhas been struggling to reduce the plant height, water requirement and time of maturity since 1970. It is also tending to introduce high iron, zinc and pro-vitamin A content varieties. To develop genetic pool to produce pure pre-basic and basic seed of different approved rice varieties is also on the account of the institute. The achievements of the institute are very outstanding. It has developed 22 basmati varieties along with first aromatic basmati variety (Bas, 370) in the world. It has also ascended the potential yield of fine varieties from 30 maunds/ acre (Bas, 370, Bas, Pak) to 75 maunds/ acre (Bas, 515) while of coarse varieties from 100 maunds/ acre to 105 maunds/ acre (Akhter, 2014).

The efforts of this institute not only shortened the crop duration (Bas, 385; Super Bas, and Bas, 2000 which ripe within 103 days instead of 130 days in case of fine while 100 days instead of 111 days in case of coarse varieties) but also plant height from 170cm (Bas, 370) to 120cm (Bas, 515) of fine varieties and 115cm to 105cm of coarse varieties.

This landmark is very helpful in reducing the chances of lodging, conserving 3 inches water without affecting the yield as well as in increasing the grain length from 6.50 mm (Bas, 198) to 7.68mm (Bas, 2000) in fine varieties while 7.07 mm (KSK 133) in coarse varieties. Benchmarking of rice parboiling technology, production of rice bran oil, direct rice seeding, mechanized transplanting and establishment

of Rice Research Station Bahawalnagerare the future development projects of the organization(Badir and Akhtar, 2014).

A technically sound farmer can only harvests the aforementioned fruits. In agrarian aspect, the technicality or capacity of a farmer can be judged on the basis of acquired knowledge, application of technology, labour and physical assets management as well as the ability to improve out-put of the farmer (World Bank, 2011:Kamruzzaman and Hiroyuki, 2008). The agricultural extension organizations improve the farmers' capacity through: transferring the innovations, educating the farmers, making them technically skillful, encouraging them for application of technologies and assess their competencies (FAO, 2013). All in one is that the ultimate objective of agricultural extension services is to make a farmer technically mature(Kamruzzaman and Hiroyuki, 2007).

In Pakistan, since 1988 private sector has also been rendering extension services along with public sector. Both sectors are hands-in-hands to improve the awareness of recommended rice production technologies among farmers. Therefore, it is need of the hour to check the effectiveness of public and private sectors in improving awareness of recommended weed, disease, and insect-pest management practices.

Materials and Methods

A survey research methodology was applied to conduct the study. The study was conducted in Gujranwala, Pakistan, the largest rice-producing district in the country.

The population or sampling frame was made up of rice growers registered with the Department of Agriculture (Extension Unit) and the largest private extension unit, a pesticide company. The largest private unit in the district was Syngenta Agrochemicals. A sample size of 342 farmers was drawn out of 2,365 rice growers from the four tehsils of the district: Gujranwala, Wazirabad, Kamoky and NoshehraVirkan (Fitz-Gibbon and Morris, 1987). The respondents from each tehsil were selected on the basis of number of farmers in the tehsil. There was: 103 respondents selected from tehsil Gujranwala; 97 respondents from tehsil Kamoky; 83 respondents from tehsil Wazirabad; and 59 respondents from tehsil NoshehraVirkan. An interview schedule was prepared in English but ad-libbed in vernacular (Punjabi) to facilitate the respondents(Flower Jr., 2004). Its validity and reliability was checked through pre-testing. Data collection was carried out by the lead author through face-to-face interviews. Of 342, 289 respondents were interviewed on their farms locally known as Deras while rest of them was at their homes or shops. Data analysis was done using the SPSS 24 (Statistical Package for Social Sciences).

The small sample size of 342 smallholder farmers is not enough to generalize the results to whole the whole country or even to the province. Though, it does help answer the research hypothesis 'Private extension services are more effective than public extension services?'

Results and discussion

Disease management

The data presented in the Table 1 show that all of the respondents were aware of *Fusariummoniliforme*(Local Name/L.N: Bakanae), and *Xanthomonasoryzaepv* (L.N: Bacterial leaf streak) diseases of rice crop, respectively. A large majority (90.6, 87.1 and 78.9%) of the respondents was aware of *Xanthomonasoryzae* (Local Name/L.N: Bacterial leaf blight), *Helminthosporumoryzae* (L.N: Brown spot) and *Pyriculoriaoryzae* (L.N: Rice blast). About two-thirds (66.7%) of growers were unaware of *Sarocladiumoryzae* (L.N: Sheath rot). Disease management practices like, Coper Oxichloride @3 g/lit for Bacterial leaf blight(Xanthomonasoryzaepv) and Glimer, Topson M @400g/acre for Bakane (Fusariummoniliforme) were known to 87.7 and 77.8% of the respondents. About 39% farmers were not aware of Tilt@200ml/acre or Score, Recodo @250ml/acre or Brisk @200 g/acre for Rice blast, Brown leaf spots.

Table 1. Distribution of the respondents according to their awareness of recommended disease management technologies**.**

Recommended disease management technologies			Awareness				Mean awareness	
			Yes		No			
	Scientific name	Local name	f	%	f	%	f	%
Disease	*Fusarium moniliforme*	Bakanae	342	100.0	-	-	279	81.7
	Xanthomonas Oryzaepv	Bacterial leaf streak	342	100.0	-	-		
	Xanthomonas oryzae	Bacterial leaf blight	310	90.6	32	09.4		
	Helminthosporumoryzae	Brown spot	298	87.1	44	12.9		
	Pyriculoria Oryzae	Rice blast	270	78.9	72	21.1		
	Sarocladium Oryzae	Sheath rot	114	33.3	228	66.7		
Disease management practices	Coper Oxichloride @3 g/lit for Bacterial leaf blight		300	87.7	42	12.3	258	75.6
	Glimer, Topson M @400g/acre for Bakane		266	77.8	76	22.2		
	Tilt@200ml/acre or Score, Recodo @250ml/acre or Brisk @200 g/acre for Rice blast, Brown leaf spots and all others		210	61.4	132	38.6		

Insect-pest management

Regarding insect/pest management, the respondents were asked whether or not they were aware of insect/pests of rice crop and recommended technologies to control them. The data in this regard are presented in Table 2.

According to the data presented in the Table 2, all of the respondents were aware of *Orthoptra* (Local Name/L.N:Grasshopper) and *Cnaphalocrocismedinalis* (L.N: Rice leaf folder). A large majority (95.9, 89.5, 86.5 and 80.9%) of the respondents were aware of *Graminellanigrifrons* (L.N: Green leafhopper), *ChiloSuppressalis*(L.N: Stem borer), *Aphidoidea* (L.N: Aphid) and *Amrascabiguttulla* (L.N: Jassid), respectively. About two-thirds (67.2%) and 71.1% of the respondents were unaware of pre-sowing management and cultural management of insect/pests, respectively. A large majority (84.8 and 77.5%) of the respondents were known to Imidacloprid or Fipronill, Bifinthrin@250ml/acre for leaf folder, aphids, jasids and Calar, Copan, Blackgold @7-14kg/acre for Grasshoppers, respectively. About three-fourth (74.9%) of the growers were unaware of Lama, Padan, Superdan, Hopo, Suprimo @9-18kg/acre for Leaf folder and Stem borers while 59.6% were not known to Turnout, Future @200ml/acre for Aphids, Jasids, Hoppers. Generally, farmers are aware of insect/pests and chemical control methods but don't know pre-sowing and cultural methods to control insect/pests. They argued that being small landholders, farming is only source of their livelihoods. We can't afford rotation of our cropping patterns because no other crop in our locality is more profitable than wheat and rice. We don't know insect resistant varieties. If such verities are available to us, we may cultivate these.

Though, these results are in line with Banjo *et al.* (2003) who described that growers were quite aware of insect/pests of major crops in Nigeria. Rehman (2003) described that few farmers' burn the stubbles of crop after harvesting in field rather than cultivation

to get rid of diseased and insect/pest affected plants before sowing of next crop to save the crop from insect attraction. This practice badly affects the beneficial soil microbes as well as degrades the environment. These results are contradictory with those of Schlosser (1999) who found that a big number of growers were not able to differentiate many key insect/pests in Jamaica.

Table 2. Distribution of the respondents according to their awareness of recommended insect/pest management technologies.

Recommended insect/pests management technologies			Awareness				Mean awareness	
			Yes		No			
	Scientific name	Local name	f	%	f	%	f	%
Insect/pests	*Orthopetra*	Grasshopper	342	100.0	-	-	315	92.2
	Cnaphalocrocismedinalis	Rice leaf folder	342	100.0	-	-		
	Graminellanigrifrons	Green leafhopper	328	95.9	14	04.1		
	ChiloSuppressalis	Stem borer	306	89.5	36	10.5		
	Aphidoidea	Aphid	296	86.5	46	13.5		
	Amrascabiguttulla	Jassid	277	80.9	65	19.1		
Pre-sowing management	Culmination of rice stubbles before 28th February		16	04.7	326	95.3	112	32.8
	Nursery raising after 20th May		95	27.8	247	72.2		
	Proper cleansing of field bunds and water channels		226	66.1	116	33.9		
Cultural management	Removal of crop residue		204	59.6	138	40.4	98	28.9
	Timely planting		138	40.4	204	59.6		
	Improved drainage		124	36.3	218	63.7		
	Crop rotation		28	08.2	314	91.8		
	Insect resistant varieties		-	-	342	100.		
Chemical control	Imidacloprid or Fipronill, Bifinthrin@250ml/acre for leaf folder, aphids, jasids		290	84.8	52	15.2	193	56.7
	Calar, Copan, Blackgold @7-14kg/acre for Grasshoppers		265	77.5	77	22.5		
	Turnout, Future @200ml/acre for Aphids, Jasids, Hoppers		134	39.2	204	59.6		
	Lama, Padan, Superdan, Hopo, Suprimo @9-18kg/acre for Leaf folder and Stem borers		86	25.1	256	74.9		

Conclusion

In the light of above results, it is concluded that rice growers were very well aware of chemical management of insect-pests, weeds, and diseases while very less aware about their biological management.

Therefore, it is recommended that public, as well as private sector, should convince farmers about the good nutritional value of crop without application of chemicals in-order to de-improve the extensive use of chemicals. Both sectors should site-specified their recommended weed, disease, and insect-pest management practices in order to improve the adoption of these practices. Both sectors should work together to improve the adoption of biological management of insect-pests, weeds, and diseases to promote climate-friendly agriculture.

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