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Impact of on Farm Testing on Low Yield of Potato due to Weeds in Bharatpur District of Eastern Rajasthan, India

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A B S T R A C T

The Present study was carried out at Bharatpur district of Eastern Rajasthan during 2015-16, 2016-17 and 2017-18. Potato is one of the most important vegetable crops of the country. The development of the Agriculture is primarily depends on the application of the scientific technologies by making the best use of available resources. One of the major constraints of traditional potato farming is low productivity due to non management of weeds. To increase the production, productivity and quality of agricultural produce, on farm testing are being conducted at various farmers' field. All the recommended practices were provided to the selected farmers. The data related to the cost of cultivation, production, productivity, gross return and net return were collected as per schedule and analyzed. Result of the present study revealed that the application of Metribuzin 70% wetable powder@ 0.5 kg. ai./ha. as early post emergence 7 days after sowing recorded the higher yield (308 q/ha,) as compared to control (273 q/ha.). The percentage increase in the yield over control 12.82 was recorded. The technology gap in terms of productivity (42 q/ha.) was computed. The technology index values 12% was recorded. The result of the study indicated the gap existed in the potential yield and demonstration yield is due to soil fertility and weather conditions. By conducting On Farm Testing of proven technology of weeds control, yield potential of potato can be increased upto great extent. This will substantially increase the income as well as the livelihood of the farming community.

Introduction

Potato (*Solanum tuberosum* L.) is basically a crop of the temperate region. However, through the process of breeding and selection, potato has acclimatized to most regions of the world. It is ranked first vegetable crop of the world in area and production and is a stable food of almost half of the world's population. It is one of the most important food crops in the world. It produces more weight and calories per unit area as compared to all other field crops (Das, 1993). It ranks top, among the root and tuber crops, followed by cassava, sweet potato and yams in volume of production and consumption and is produced in 140 countries (FAO, 2004). In volume of crop production, it ranks fourth following wheat, maize and rice in the world. It is regarded as a high potential food security crop

because of its ability to provide a high yield of high quality product per unit with a shorter crop cycle (mostly less than 120 days) than major cereal crops like maize, sorghum etc. (Adane *et al.*, 2010). In total production India ranks second after China. Potato is grown in almost all the states in India except Kerala. However, Bihar, Uttar Pradesh and West Bengal account for nearly 75 per cent of the total area and 80 per cent of the total production (Dhaliwal, 2014). In India, potato had 2.117 million ha. area with the production of 43.417 million tonnes and productivity 20500 kg/ha. during 2015-16 (Anonymous 2017). In Rajasthan, potato had 0.01432 million ha. area with the production of 0.22983 million tonnes and productivity of 16050 kg/ha. during 2015-16 (Anonymous 2017). Potato is also an important source of minerals like calcium, potassium, phosphorus, magnesium, iron and vitamins like B_1,B_2,B_6 and C. Potato, though is poor in protein content (2 per cent), it is an important source of essential amino acids like lysine, methionine, cysteine, phenylalanine, tryptophan etc. It has 18 per cent starch. It is an integral part of every vegetables culinary preparation. It is being used as boiled, fried, baked, mashed, stewed and roasted. The important processed products include papad, chips flakes, French fries, flour, starch etc. It is also used on a small scale for production of starch, alcohol (Vodka) and ethyl alcohol (ethanol) to be mixed with petrol and as livestock feed (Swarup, 2006).

There are several constraints in potato production of which weeds often pose a serious problem. Even though potato plants have robust growing and quick spreading nature but it turns as a weak competitor with weeds. Potato is commonly grown on highly productive and irrigated soil in which the weeds emerge even before the emergence of potato and get established earlier. Wider spacing frequent irrigation and liberal use of maures and fertilizers provide favourable conditions for an early start of weeds well before the emergence of potato plants. Weeds not only compete with the crop plants for resources like nutrient, moisture, space and sunlight etc. but also serve as an alternative hosts for several insect, pest and diseases. Yield reduction in potato can be as high as 62% (Singh and Bhan, 1999) and 74 % (Ahuja *et al*., 1999). The yield reduction due to weeds in potato is estimated to be as high as 10 -80 % (Lal and Gupta, 1984). It was observed that the most critical period of crop-weed competition is first 4-6 weeks after planting when the crop must be kept free from weeds so, control of weeds in the initial stages appears imperative as it plays an important role in minimizing the tuber production. In ridge –bed furrow sowing system manual weeding is not done. Hence, chemical weed control appears to hold a great promise in dealing with effective, timely and economic weed management. A field trial was carried out at the farmer's field at Bharatpur District of Rajasthan. It comes in Agro-climatic zone of Rajasthan III B flood prone Eastern Plain. Here, generally in winters minimum temperature goes to 2-3^{o}C and in summer maximum temperature reaches to 48^{o}C. Annual rainfall is 664 mm per year. There is lot of scope of potato growing in winter season under assured irrigation facility. Generally, the agricultural technology is not accepted by the farmers as such in all respects. There is always gap between the recommended technology by the scientist and its modified form at the farmer's level which is major absentee in the efforts of increasing agricultural production in the country. It is need of the hour to reduce this technological gap between the agricultural technology recommended by the scientists or researchers and its acceptance by the farmers on their field. In view of the above facts, on farm testing were undertaken in a systematic manner on farmer's field to show the worth of

a new technology and convince the farmers and field level extension functionaries to adopt in their farming system.

The main objective of On Farm Testing (OFT) is to introduce suitable agriculture practices like high yielding varieties, seed treatment, spacing, nutrient management, weeds management, pest and disease management etc. among the farmers accompanied with organizing extension programmes (field day) for horizontal dissemination of the technologies. Farmers in this region usually grow potato without having proper knowledge on use of herbicide. Hence, in on farm testing use of weedicide Metribuzin 70% wetable powder@ 0.5 kg. a i./ ha as early post emergence 7 days after sowing with other recommended package of practices was tried to manage the weeds in the potato crop at selected farmers fields.

Materials and Methods

On farm testing were conducted in Bharatpur district of Eastern Rajasthan during Rabi 2015-16, 2016-17and 2017-18 under irrigated farming situation. Potato variety Kufri Bahar (3797) was sown by the farmers. All the participating farmers were trained on various aspects of potato production technologies. The field was prepared by deep ploughing and harrowing after kharif crops. The seeds (tubers) were sown in well prepared field during last week of October to first week of November. All the recommended practices i.e. seed treatment by fungicide, spacing, recommended dose of manure and fertilizers, weed management, and insect pest management were provided to the farmers. About 2000 kg seed tubers with the average weight of 35-45 g per tuber were sown by ridge and furrow system following the spacing of 45 cm X 22.5 cm after treatment with fungicide Carbendazim@1.5 g/l water for 25-30 minutes dipping. The fertilizer dose of 60-75 kg nitrogen,80-100 kg phosphorus,80-100 kg potassium,250-300 kg gypsum and 25kg Zinc Sulphate/ha. were applied as basal in both treatment. Another 60-75 kg nitrogen was top dressed 30-35 days after sowing. Herbicide Metribuzin 70 % wettable Powder @ 0.5 kg a.i./ha was applied as early post emergence 7 days after sowing using 1000 liters of water. Weed count was made using quadrate having the size of 1metre X 1metre area in both treatments and total dry weight of the weeds was measured before harvesting. Crop was harvested- from 25-28 Feb. 2018.The data related to cost of cultivation, production, productivity, total return and net return were collected in all treatments as per schedule from all selected farmers. An average of cost of cultivation, yield, net returns of different farmers was analyzed by the formula.

Average = [F_1+ F_2+F_3.....Fn]/N

where, F_1 = Farmer, N = No. of Farmers

In the present study, technology index was operationally defined as the technical feasibility obtained due to implementation of On Farm Testing in Potato. To estimate the technology gap, extension gap and technology index following formula used by Samui *et al.* (2000) have been used.

Technology Gap = Pi (Potential Yield) – Di (Demonstration Yield)

Extension Gap = Di (Demonstration Yield) – Fi (Farmers yield)

Technology index – [(Potential Yield – Demonstration yield) X 100]/ Potential yield

Relative weed density

It is defined as the dominance of particular weed species over other species in number in

a mixture of weed population & expressed in percentage.

RWD = NPW x 100 where, RWD = Relative weed density

NPTW NPW = No. of a particular species per unit area

NPTW = No.of total weed species per unit area (Table 1).

Weed control efficiency (WCE)

Calculated to determine the variation in the dry matter weight accumulated due to competition with the potato plants of the treated plot or to estimate the comperative ability of weeds at different stage as compare to weedy check (Walia, 2003) and was computed as

WCE= DWC-DWTX100

where, WCE = weed control efficiency

DWC DWC =Dry weight of weeds in control plot

DWT = Dry weight of weeds in treated plot

Results and Discussion

Performance of OFT

A comparison of productivity levels between demonstrated technology to manage the weeds in crop and control treatment (without use of weedicide) is shown in Table 2. Metribuzin is a member of the substituted as – trizinone group of herbicides. It is a selective systematic herebicide. It is a pre-emergeng herbicide and can also applied as early post. It has broad spectrum control of both grasses and broad leaf weeds. It is absorbed predominantly by the leaves, with translocation in the xylem. During the period of study, it was recorded that On farm testing, application of Metribuzin at seven days after sowing recorded the highest yield (308.00q/ha) than control practice (273 q/ha).

The Percentage increase in the yield (12.82) over control practice was recorded. Similarly, Yield enhancement in different crops in front line demonstration had apply been documented by Hiremath *et al.,* (2007), Mishra *et al.,* (2009), Kumar *et al.,* (2010), Surywanshi and Prakash (1993) and Dhaka *et al.,* (2010). From these results it is evident that the performance of improved technology application of Metribuzin to manage weeds in the crop was found to be better than the control practice under same environment conditions.

The farmers were motivated by seeing the results in term of productivity and they are adopting the technologies. The yield of the On Farm Testing and potential yield of the crop was compared to estimate the yield gaps which were further categorized into technology index.

Technology gap

The technology gap shows the difference between potential yields over demonstration yield of the technology. The potential yield of the variety Kufri Bahar is 350.00 q/ha (Gorakh Singh, 2013). The Technology gap 42.00 q/ha was recorded. The on farm testing was laid down under the supervision of KVK specialist at the farmers' field, there exist a gap between the potential yield and demonstration yield. This may be due to the soil fertitlity and weather condition. Hence location specific recommendations are necessary to bridge the gap. These findings are similar to the finding of Sharma and Sharma (2004) in oil seeds at Baran District of Rajasthan.

Technology index

Technology index shows the feasibility of the technology at the farmer's field. The lower the value of technology index, more is the feasibility of the particular technology. The result of Study depicted in Table 2 revealed that the technology index value was 12.0. It means the technology application of Metribuzin seven days after sowing is suitable for Bharatpur district of Eastern Rajasthan. The result of the present study is in consonance with the findings of Hiremath and Nagaraju (2009) in onion. Mukharjee *et al.*(2012) reported that the application of metribuzin @ 0.30 kg/ha. (early post-emergence) or pendimethalin @ 0.60 kg/ha. (pre-emergence) in ridge planted potato followed by earthing up at 45 days after planting were effective for controlling weeds, getting higher production and profitability. Tomar *et al.*(2008) reported that herbicide prometryne @ 1.0 kg a.i./ha pre-emergence was found most effective to control the weds resulting in higher yield of potato as well as higher net return and B: C ratio. The next best treatments were pre-emergence application pendimethalin @ 1.0 kg/Ha., metribuzin @ 0.5 kg/ha. and two hand weedings (Table 4).

Table.1 Weeds density in control plot

S.No.	Name of Weed present in control plot	Number of weeds / M^2 area	Relative weed density %	Fresh Weight of weeds / M^2	Dry weight of weeds / M^2	Weed Control Efficiency %
1	Chenopodium murale	37	90.24	2500 gram	400 gram	100
2	Melilotus indicus	3	7.32			
3	Phalaris minor	1	2.44			

*No weeds found in treated plot

Table.2 Yield, technology gap and technology index of demonstration (Average of 3 years)

Variables	Yield (q/ha)	Increase (%) over	Technology gap (q/ha)	Technology index (%)
T_1 Control	273	-	-	-
T_2 Application of Metribuzin 70% wetable powder@ 0.5 kg. a i./ ha	308	12.82	42	12

Table.3 Economics of on farm testing

Variables	Cost of Cultivation (Rs/ha.)	Gross return (Rs/ha.)	Net return (Rs/ha.)	Benefit: cost ratio
T_1 control	96667	198900	102233	1:2.06
T_2 Application of Metribuzin 70% wetable powder@ 0.5 kg. a i./ ha	100333	223833	123500	1:2.23
Additional in T_2 treatment application	3666	24933	21267	6.80

*incremental benefit: cost ratio

Table.4

Variables	Cost of Cultivation (Rs/ha.)	Gross return (Rs/ha.)	Net return (Rs/ha.)	Benefit: cost ratio
T_1 control	96667	198900	102233	1:2.06
T_2 Application of Metribuzin 70% wetable powder@ 0.5 kg. a i./ ha	100333	223833	123500	1:2.23
Additional in T_2 treatment application	3666	24933	21267	6.80

*incremental benefit: cost ratio

Economics of on farm testing

Economics of potato production under On Farm Testing was recorded and the results of the study have been presented in Table 3. The results of economic analysis of potato production revealed that application of Metribuzin seven days after sowing recorded higher gross return (223833 Rs /ha) and net return. (123500 Rs) with higher benefit cost ratio (2.23) as compared to control. These results are in accordance with findings of Tomar *et al.* (2008),. Mukharjee *et al.*(2012), Sahu and Singh (1995), Sahu and Solanki (1991), Burman *et al.,* (2004), Hiremath *et al.*, (2007) and Hiremath and Nagaraju (2009), further, additional cost of Rs 3666 per ha. in demonstration has increased additional net return Rs 21267 per ha. with incremental benefit cost ratio 6.80 suggesting its higher profitability and economic viability of the demonstration. More or less similar results were also reported by Hiremath and Nagaraju (2009) and Dhaka *et al.,* (2010).

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