

FRONT LINE DEMONSTRATION OF PLANT EXTRACT BASED BIO FUNGICIDEON MANAGING POTATO CROP DISEASES

Shishir Kumar* and T.D.Mishra**,

Subject Matter Specialist Agronomy*, Horticulture**

Directorate of Extension, Sam Higginbottom University of Agriculture, Technology and Sciences,
Prayagraj – 211007 (U.P.) India

ABSTRACT: The present study was conducted by Directorate of Extension, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (U.P.) India, during 2023-24 in the Rabi season with demonstrations on potato covering an area of 6.50 hectare in Bhadohi district of Uttar Pradesh to exhibit the use of botanical extract Controller for the control of phytoplastic and viral diseases in early cultivation of potato. Phytoplastic diseases as purple top, which is broom and viral mainly alfa alfa mosaic, potato virus Y on early maturing variety Pukraj that fetches good price to farmers due to early maturity. Climate also plays an important role during this cultivation, higher temperatures aggravate these diseases. Generally the crop is harvested between 85 to 100 days as at that time table potato rates are high. Weekly spray of Controller@ 5ml per litre water was done till the date of harvest. The control was treated with chemical fungicides on as and when required basis. The study was very interesting as for the first time we came across a product that claimed a check on phytoplastic and viral diseases.. The results were compared between Field Demonstration plots and control plots. From the demonstrations, it was observed that the improved potato variety kufri Pukhraj recorded the higher yield 325q/ha compared from the fields treated with Controller and 302 q/ha when the fungal management was done by the use of Mancozeb when 95 days crop was harvested. The Increase in the demonstration yield over control was 7.07 per cent. The extension gap, technology gap and technology index were recorded 23.00q/ha, 50.00q/ha and 15.38% respectively in the trial of potato crop. The increment in yield of potato crop under demonstrations of foliar spray of bio extract (Controller) was due to the retardation of phytoplastic, viral diseases and the increase in the size of the tubers in treated plots. . Use of bio extract such as Controller gave higher mean net return of Rs. 580200.00 per hectare with a benefit cost ratio 5.67 as compared to chemical fungicide (Rs. 481180.00 per hectare benefit cost ratio 5.00).

KEY WORDS: Field demonstration, Potato, Botanical extracts, yield, extension gap, technology, gap, technology index, BC ratio.

Potato (*Solanum tuberosum L.*) a solanaceae family plant, is very popular and important vegetable grown in all over world. It is the fourth important crop after maize, wheat and rice. Potato (*Solanum tuberosum L.*) is a high yielding, nutrient exhaustive and short duration crop needs higher quantities of fertilizers and plant is protection as compared to other crops. A normal potato crop yielding 30 t/ha removes about 100 kg N/ha from soil (Pandey et al., 2006). However, continuous and excessive use of chemical fertilizers is causing ecological and health hazards as well as deteriorating the soil health resulting decline in crop yields. Under these circumstances, organic sources play a vital role in improving the soil fertility and productivity of crop.

Two major challenges need to be addressed for sustainable organic potato production ensuring adequate mineral nutrition of potato crop, reducing stresses that result in diseases. . In this regard, the selection of effective and safe microbiological fungicides to reduce the population density of phytopathogenic species is of particular importance. Judicious use of organic manures with chemical fertilizers and the use of bio pest control measures can be an effective solution. In organic farming, plants are healthy as they are provided with provided with sufficient nutrients and favorable micro biota. This contributes to an increase in plant disease resistance and protection from phytopathogenic microorganisms. At the same time, a favorable micro biota promotes the supply of more nutrients to the plants, which, in turn, promotes more active plant growth. The

considered model of organic potato predicts its development, using the emerging weather characteristics, forming favorable soil conditions and regulating the composition of its micro ecosystems by introducing biological products based on microbes-antagonists of phytopathogens.

One of the significant worries in this day is the quick genetic degradation especially in crops prone to phytoplasma, .Its effect is visible in sugarcane, apple .grapes crops greatly infected with phytoplasma. Non judicious use of fertilizers could be a reason for it Natural nitrogen and phosphorus, ecologically benevolent manures creatures, for example, microscopic organisms, growths and cyanobacteria might be considered as the watchword for taking care of such issue. Thus, this may upgrade plant supplements take-up and advance plant development. Moreover, the awareness towards the use of organically grown food especially chemical free vegetables and fruits is also a major concern of study in this research. We have tried to reduce the use of chemical fungicides.

Conducting of front line demonstrations on farmer's field help to identify the constraints and potential of the potato in specific area as well as it helps in improving the economic and social status of the farmers. The aim of the front line demonstration is to convey the technical message to farmers that if they use botanical extracts in place of chemicals could lead in higher production and quality crop. The improved technology packages were also found to be financially

attractive. Yet, adoption levels for several components of the improved technology were very low, emphasizing the need for better dissemination (Kiresure *et al.*, 2001). Several biotic, abiotic and socio-economic constraints inhibit exploitation of the yield potential and those needs to be addressed. The district Bhadohi of Uttar Pradesh has sizeable area under potato cultivation but the productivity level is medium. The reasons for medium productivity are poor knowledge about improved crop production and protection technologies and their management. Keeping the above point in view, the front line demonstrations on potato using improved production technologies with special emphasis to phytoplasma and viral control in early potato crop was studied conducted and the regular use of Controller was found to be effective in controlling purple top, witches broom potato virusY and other mycoplasmicdiseases.

MATERIALS AND METHODS

Demonstration for the study of botanical extract Controller were made where controller botanical extract was sprayed at weekly intervals on the potato crop from 4 leaf stage to the final day of harvest @ 5ml per liter water and chemical spray of fungicides on as and when required basis. Insect control was done with insecticides. They were sprayed in same frequency on treated and control. Experiments were conducted by the Directorate of Extension, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during Rabi season of 2023-24 at the farmer's field of five adopted villages in Bhadohi district of Uttar Pradesh. An area of 6.5 ha was covered with plot size 0.25 ha under front line demonstration with active participation of 20 farmers.

Material for the present study with respect to FLDs and control has been given in table-1. In case of local check plots, existing practices being used by farmers were followed. In general, the soil of the district is sandy loam in texture, which is low organic carbon (0.02–0.46%), available phosphorus (10–12 kg/ha) and medium to high in potash. Comparison was made between the regular use of Controller botanical fungicide at weekly intervals and chemical fungicide 'as and when required. In demonstration plot, regular use of Controller fungicide was done at weekly intervals and the use of chemical fungicides was done as and when required through front line demonstration of different locations.

ABOUT BIO FUNGICIDE (CONTROLLER)

This product Bio Extract (**Controller**) is made by the Hari Organic Manure Limited, Janakpuri, district Saharanpur. Controller is an extract of herbs which cures phytoplasmonic and other incurable diseases in plants. These diseases often occur in vegetables, fruits and flowers. **Controller** increases the resistance power of the plant. As a result, the controller creates strength in the plants to fight incurable diseases. These diseases usually come from seeds and soil and weaken the plant's

immunity. Regular spray of bio fungicide, 4 -5 ml/liter water or 600-800 ml. Repeat after 7 days in adverse weather. While other side we use the chemical fungicides such like Mancozeb in same half part of the field as and when required and then found the production effect on the crop.

Visit of farmers and extension functionaries was organized at demonstration plots to disseminate the message at large scale. The demonstration farmers were facilitated by Directorate of Extension Scientists in performing field operations like sowing, weeding, irrigation, spraying, bio extract and harvesting etc. during the course of training and visit. The necessary steps for selection of site and farmers, layout of demonstration etc. were followed as suggested by Choudhary (1999). The traditional practices were maintained in case of local checks. The data were collected from front line demonstration plots as well as control plots (farmer's practices) and finally the extension gap, technology gap and technology index were worked out (Samui *et al.*, 2000).

RESULTS AND DISCUSSION

The crop yield of potato obtained under recommended practices as well as farmer's practice is presented in table 2. The crop yield of potato 325 q/ha, under demonstration plot regularly treated with bio extract **Controller** as against a yield 302 q/ha in control plots with chemical fungicide. In comparison to control plots, there was an increase of 7.07 % higher tuber yield, during 2023-24. The higher production of potato crop yield obtained under recommended practice was due to the retardation of phytoplasmonic, viral diseases and the increase in the size of the tubers in treated plots. The similar results of yield enhancement in potato crop impact of demonstration have been documented by Lalit *et al.* (2015) and Mbuyisa *et al.* (2023).

Extension and technology gap

The extension gap showed an increasing trend. The extension gap during the study observed 23.00q/ha which emphasizes the need to educate the farmers through various means for adoption of improved agricultural production technologies with the use of botanical products in order to counteract the trend of the vast extension gap. This frightening tendency of the use of chemical fungicides that prevails in the mind of the farmer can be easily overpowered by the use of botanical pesticides in the cultivation of potato.

The technology gap is the difference between the demonstration yield and potential yield. The technology gap was observed 50.00 q/ha during the study period. This gap exists due to variation in the soil fertility and climatic conditions. These findings are similar to the findings of Lalit *et al.* (2015) and Ehiobu *et al.* (2022). Technology index showed the feasibility of evolved technology at the farmer's field. The lower is the value of technology index; the more is the feasibility of technology demonstrated. The technology index was observed 15.38% during the period may be attributed to the difference in the soil

fertility status, weather condition insect-pest and diseases attack on the crop. The results of the present study are in recurrence with the findings of Mbuyisa *et al.* (2023).

Yield attributing parameters

The yield attributing parameters like tuber weight (g) and tuber yield per ha of potato obtained from treated and control plots which include demonstration plots treated with Controller at weekly intervals and the control plots treated with chemical fungicides on "as and when required basis" are presented in table 3. The tuber weight (g) of potato ranged from 100.50 to 140.90 under treated conditions as against a range from 80.50 to

120.50 recorded under control. Similarly, higher yield per acre recorded under treated plots ranged between 30 to 34 tons as compared to control plots ranging from 25 to 30 tons. The higher tuber weight and tuber yield of potato in treated as compared to control is due to the regular use of the recommended dose of bio extract (**Controller**) and timely irrigation management on potato crop during the year of demonstration similar results have been reported earlier by Akbar *et al.* (2012) and Mbuyisa *et al.* (2023).

Economics of front line demonstration

The inputs and outputs prices of commodities prevailed during the year of demonstration were taken for calculating cost of cultivation, net returns and benefit cost of ratio (table 4). The investment on production by regular spray of Controller at weekly internal was Rs. 102300 per ha against control Rs. 96320. Cultivation of potato crop under demonstration condition with the regular use of botanical extract

Controller gave higher net return of Rs. 580200 per ha compared to Rs. 481180 per ha in control plots under chemical fungicides during the study. The average benefit cost ratio in treated plots was 5.67 and that of control plots was 5.00. This is the result of the use of botanical extract giving higher yields and better marketing prices due to the size and color in treated plots. Similar results have been reported earlier on potato by Singh *et al.* (2012) and Pradeep (2015).

Print by Bright **CONCLUSIONS**

CONCLUSIONS

The productivity enhancement demonstration over control in potato cultivation created greater awareness and motivated the other farmers to adopt the use of Controller in early cultivation of Pukraj when it is to be harvested within three months of sowing. The demonstration's results underline the potential for **increased productivity and profitability** in potato cultivation when using advanced methods like bio fungicide Controller. However, to fully leverage this potential, **extension services, resource accessibility, and farmer education** must be strengthened. Additionally, fine-tuning the technologies based on **local conditions** and continuously monitoring the outcomes will help further bridge the technology and extension gaps.

The use of **botanical extracts** for plant pest management, as seen in the study with the bio fungicide **Controller**, aligns well with the current trend of **organic farming**. This shift reflects farmers' growing interest in sustainable agriculture, where there is a focus on reducing reliance on synthetic chemicals and adopting natural alternatives and has increasingly gained attention from both consumers and the government over time.

Table-1: Particulars showing the details of Potato grown under impact_of demonstrations and farmers practices (2023-24)

Farmers practices (2023-24)			
S. N.	Particulars	Demonstration plots	Control plots
1	Improved variety	Kufri Pukhraj	Kufri Pukhraj
2	Seed rate	20-22 q /ha	20-22 q /ha
3	Time of sowing	5 Oct to 10 Nov	5 Oct to 10 Nov
4	Insect management	Chemical insecticides	Same as in treated
5	Seed treatment	Seed Treatment with bio fungicide Controller	Carbendazim 50 WP @ 2.5 gm/kg seed
6	Use of Bio fungicide	Controller-Plant extract bio fungicide with technical guidance	Mancozeb and Copper-based fungicides
7	Basal Application of fertilizers	120 N:60P:90 K (kg/ha)	120 N:60P:90 K (kg/ha)

Year	Area (ha)	No. of farmers	Yield q/ha			Increase over control plots(%)	Technology gap (q/ha)	Extension gap (q/ha)	Technology Index (%)
			Potential	Trial (Controller Fungicide)	Control plots (Chemical Fungicide)				
2023	100	500	1500	1450	1400	3.33%	50	30	85
2024	120	600	1600	1550	1500	3.33%	50	30	85
2025	140	700	1700	1650	1600	3.33%	50	30	85
2026	160	800	1800	1750	1700	3.33%	50	30	85
2027	180	900	1900	1850	1800	3.33%	50	30	85
2028	200	1000	2000	1950	1900	3.33%	50	30	85
2029	220	1100	2100	2050	2000	3.33%	50	30	85
2030	240	1200	2200	2150	2100	3.33%	50	30	85
2031	260	1300	2300	2250	2200	3.33%	50	30	85
2032	280	1400	2400	2350	2300	3.33%	50	30	85
2033	300	1500	2500	2450	2400	3.33%	50	30	85
2034	320	1600	2600	2550	2500	3.33%	50	30	85
2035	340	1700	2700	2650	2600	3.33%	50	30	85
2036	360	1800	2800	2750	2700	3.33%	50	30	85
2037	380	1900	2900	2850	2800	3.33%	50	30	85
2038	400	2000	3000	2950	2900	3.33%	50	30	85
2039	420	2100	3100	3050	3000	3.33%	50	30	85
2040	440	2200	3200	3150	3100	3.33%	50	30	85
2041	460	2300	3300	3250	3200	3.33%	50	30	85
2042	480	2400	3400	3350	3300	3.33%	50	30	85
2043	500	2500	3500	3450	3400	3.33%	50	30	85
2044	520	2600	3600	3550	3500	3.33%	50	30	85
2045	540	2700	3700	3650	3600	3.33%	50	30	85
2046	560	2800	3800	3750	3700	3.33%	50	30	85
2047	580	2900	3900	3850	3800	3.33%	50	30	85
2048	600	3000	4000	3950	3900	3.33%	50	30	85
2049	620	3100	4100	4050	4000	3.33%	50	30	85
2050	640	3200	4200	4150	4100	3.33%	50	30	85
2051	660	3300	4300	4250	4200	3.33%	50	30	85
2052	680	3400	4400	4350	4300	3.33%	50	30	85
2053	700	3500	4500	4450	4400	3.33%	50	30	85
2054	720	3600	4600	4550	4500	3.33%	50	30	85
2055	740	3700	4700	4650	4600	3.33%	50	30	85
2056	760	3800	4800	4750	4700	3.33%	50	30	85
2057	780	3900	4900	4850	4800	3.33%	50	30	85
2058	800	4000	5000	4950	4900	3.33%	50	30	85
2059	820	4100	5100	5050	5000	3.33%	50	30	85
2060	840	4200	5200	5150	5100	3.33%	50	30	85
2061	860	4300	5300	5250	5200	3.33%	50	30	85
2062	880	4400	5400	5350	5300	3.33%	50	30	85
2063	900	4500	5500	5450	5400	3.33%	50	30	85
2064	920	4600	5600	5550	5500	3.33%	50	30	85
2065	940	4700	5700	5650	5600	3.33%	50	30	85
2066	960	4800	5800	5750	5700	3.33%	50	30	85
2067	980	4900	5900	5850	5800	3.33%	50	30	85
2068	1000	5000	6000	5950	5900	3.33%	50	30	85
2069	1020	5100	6100	6050	6000	3.33%	50	30	85
2070	1040	5200	6200	6150	6100	3.33%	50	30	85
2071	1060	5300	6300	6250	6200	3.33%	50	30	85
2072	1080	5400	6400	6350	6300	3.33%	50	30	85
2073	1100	5500	6500	6450	6400	3.33%	50	30	85
2074	1120	5600	6600	6550	6500	3.33%	50	30	85
2075	1140	5700	6700	6650	6600	3.33%	50	30	85
2076	1160	5800	6800	6750	6700	3.33%	50	30	85
2077	1180	5900	6900	6850	6800	3.33%	50	30	85
2078	1200	6000	7000	6950	6900	3.33%	50	30	85
2079	1220	6100	7100	7050	7000	3.33%	50	30	85
2080	1240	6200	7200	7150	7100	3.33%	50	30	85
2081	1260	6300	7300	7250	7200	3.33%	50	30	85
2082	1280	6400	7400	7350	7300	3.33%	50	30	85
2083	1300	6500	7500	7450	7400	3.33%	50	30	85
2084	1320	6600	7600	7550	7500	3.33%	50	30	85
2085	1340	6700	7700	7650	7600	3.33%	50	30	85
2086	1360	6800	7800	7750	7700	3.33%	50	30	85
2087	1380	6900	7900	7850	7800	3.33%	50	30	85
2088	1400	7000	8000	7950	7900	3.33%	50	30	85
2089	1420	7100	8100	8050	8000	3.33%	50	30	85
2090	1440	7200	8200	8150	8100	3.33%	50	30	85
2091	1460	7300	8300	8250	8200	3.33%	50	30	85
2092	1480	7400	8400	8350	8300	3.33%	50	30	85
2093	1500	7500	8500	8450	8400	3.33%	50	30	85
2094	1520	7600	8600	8550	8500	3.33%	50	30	85
2095	1540	7700	8700	8650	8600	3.33%	50	30	85
2096	1560	7800	8800	8750	8700	3.33%	50	30	85
2097	1580	7900	8900	8850	8800	3.33%	50	30	85
2098	1600	8000	9000	8950	8900	3.33%	50	30	85
2099	1620	8100	9100	9050	9000	3.33%	50	30	85
2010	1640	8200	9200	9150	9100	3.33%	50	30	85
2011	1660	8300	9300	9250	9200	3.33%	50	30	85
2012	1680	8400	9400	9350	9300	3.33%	50	30	85
2013	1700	8500	9500	9450	9400	3.33%	50	30	85
2014	1720	8600	9600	9550	9500	3.33%	50	30	85
2015	1740	8700	9700	9650	9600	3.33%	50	30	85
2016	1760	8800	9800	9750	9700	3.33%	50	30	85
2017	1780	8900	9900	9850	9800	3.33%	50	30	85
2018	1800	9000	10000	9950	9900	3.33%	50	30	85
2019	1820	9100	10100	10050	10000	3.33%	50	30	85
2020	1840	9200	10200	10150	10100	3.33%	50	30	85
2021	1860	9300	10300	10250	10200	3.33%	50	30	85
2022	1880	9400	10400	10350	10300	3.33%	50	30	85
2023	1900	9500	10500	10450	10400	3.33%	50	30	85
2024	1920	9600	10600	10550	10500	3.33%	50	30	85
2025	1940	9700	10700	10650	10600	3.33%	50	30	85
2026	1960	9800	10800	10750	10700	3.33%	50	30	85
2027	1980	9900	10900	10850	10800	3.33%	50	30	85
2028	2000	10000	11000	10950	10900	3.33%	50	30	85
2029	2020	10100	11100	11050	11000	3.33%	50	30	85
2030	2040	10200	11200	11150	11100	3.33%	50	30	85
2031	2060	10300	11300	11250	11200	3.33%	50	30	85
2032	2080	10400	11400	11350	11300	3.33%	50	30	85
2033	2100	10500	11500	11450	11400	3.33%	50	30	85
2034	2120	10600	11600	11550	11500	3.33%	50	30	85
2035	2140	10700	11700	11650	11600	3.33%	50	30	85
2036	2160	10800	11800	11750	11700	3.33%	50	30	85
2037	2180	10900	11900	11850	11800	3.33%	50	30	85
2038	2200	11000	12000	11950	11900	3.33%	50	30	85
2039	2220	11100	12100	12050	12000	3.33%	50	30	85
2040	2240	11200	12200	12150	12100	3.33%	50	30	85
2041	2260	11300	12300	12250	12200	3.33%	50	30	85
2042	2280	11400	12400	12350	12300	3.33%	50	30	85
2043	2300	11500	12500	12450	12400	3.33%	50	30	85
2044	2320	11600	12600	12550	12500	3.33%	50	30	85
2045	2340	11700	12700	12650	12600	3.33%	50	30	85
2046	2360	11800	12800	12750	12700	3.33%	50	30	85
2047	2380	11900	12900	12850	12800	3.33%	50	30	85
2048	2400	12000	13000	12950	12900	3.33%	50	30	85
2049	2420	12100	13100	13050	13000	3.33%	50	30	85
2050	2440	12200	13200	13150	13100	3.33%	50	30	85
2051	2460	12300	13300	13250	13200	3.33%	50	30	85
2052	2480	12400	13400	13350	13300	3.33%	50	30	85
2053	2500	12500	13500	13450	13400	3.33%	50	30	85
2054	2520	12600	13600	13550	13500	3.33%	50	30	85
2055	2540	12700	13700	13650	13600	3.33%	50	30	85
2056	2560	12800	13800	13750	13700	3.33%	50	30	85
2057	2580	12900	13900	13850	13800	3.33%	50	30	85
2058	2600	13000	14000	13950	13900	3.33%	50	30	85
2059	2620	13100	14100	14050	14000	3.33%	50	30	85
2060	2640	13200	14200	14150	14100	3.33%	50	30	85
2061	2660	13300	14300	14250	14200	3.33%	50	30	85
2062	2680	13400	14400	14350	14300	3.33%	50	30	85
2063	2700	13500	14500	14450	14400	3.33%	50	30	85
2064	2720	13600	14600	14550	14500	3.33%	50	30	85
2065	2740	13700	14700	14650	14600	3.33%	50		

2023 -24	4	16	375	325	302	7.07	50	23	15.38
-------------	---	----	-----	-----	-----	------	----	----	-------

Table- 2: Production yield and gap analysis of impact of demonstrations on potatocrop

Table- 3: Yield parameters under demonstrations and existing farmers practice.

Yield parameters	Demonstration plots	Control plots
Tuber Weight (g)	100.50-140.90	80.50 -120.50
Yield Per Hectare (t/ha)	30 – 34	25 – 30

Table-4: Economic analysis of demonstrated plots and control plots

Year	Average cost of cultivation (Rs/ha)		Average gross return (Rs./ha)		Average net return (Rs./ha)		B : C ratio	
	Trial (Controller fungicide)	Control plots (Chemical fungicides)	Trial (Controller fungicide)	Control plots (Chemical fungicides)	Trial (Controller fungicide)	Control plots (Chemical fungicides)	Trial (Controller fungicide)	Control plots (Chemical fungicides)
2023-24	102300	96320	682500	577500	580200	481180	5.67	5

REFERENCES

- Akbar, M. F., Haq, M. A., Yasmin, N., & Khan, M. F. (2012). Management of potato leaf hopper (*Amrasca devastans* Dist.) with biofungicides in comparison with conventional fungicides on autumn potato crop. *Pakistan Journal of Zoology*, 44(2).
- Anonymous (2011). *Agricultural Studies Division, Directorate of Economics and Statics*, Department of Agriculture and Cooperation, U.P. India.
- Choudhary, B. N. (1999). *Krishi Vigyan Kendra – A Guide for KVK Managers*, Publication, division of Agricultural Extension, ICAR, 73 – 78.
- Ehiobu, J., Idamokoro, E., & Afolayan, A. (2022). Biofungicides for improvement of potato (*Solanum tuberosum* L) production. *Scientifica*, 2022 (1), 1405900.
- Mbuyisa, Siphokuhle and Bertling, Isa & Ngcobo, Bonga Lewis. (2023) Foliar Application with Plant-Derived Extracts Enhances Growth, Physiological Parameters, and Yield of Potatoes (*Solanum tuberosum* L.). 34. 10.3390/IECAG2023-15385.
- Pradip, Pagaria (2015) Role of front line demonstration on transfer of potato production technologies in Barmer district of Rajasthan. *Agriculture Update*, 10(3) : 245 – 248.
- Samui, S. K., S. Mitra, D. K. Roy, A. K. Mandal and D. Saha (2000). Evolution of front line demonstration on groundnut. *J. Indian Soc. Coastal Agric. Res.*, 18 (2) : 180 – 183.
- Singh, Jagmohan, B. S. Dhillon, Astha and Parvindar Singh (2012). Front line demonstration. An effective tool for increasing the productivity of summer potato in Amritsar district of Punjab. *Asian J. Soil Sci.*, 7(2) : 315 – 318.
- Yadav, V. P. S., R. Kumar, A. K. Deshwal, R. S. Raman, B. K. Sharma and S. L. Bhela (2007). Boosting pulse production through frontline demonstration. *Indian Res. J. Extn. Edu.*, 7 (2&3).