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Productivity and profitability of Urd (*Vigna mungo L.*) as influenced by PUSA Hydrogel under rainfed condition in hilly region of Uttarakhand

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ABSTRACT
An On Farm Trial (OFT) was conducted to evaluate the effect of PUSA Hydrogel in urd (Vigna mungo L.) in rainfed condition of the hilly region of Uttarakhand during 2017-18 and 2018-19 in 1 ha area during kharif season by KVK, Tehri Garhwal. It is situated in Western Himalayan Region. In the hills of Uttarakhand, farmers usually grow rice, wheat, millets, vegetables and pulses. But sometimes the production is not found satisfactory. The major constraints responsible for this untapped production are adverse weather condition and inappropriate production practices. Major part of the hills of Uttarakhand is rainfed and farmers totally depend on rainfall for irrigation. There is a considerable scope for enhancement in crop productivity by conserving water in the field. So use of PUSA Hydrogel along with traditional method to conserve the moisture in the field was studied. The results reveals that during 2017-18, the no. of pods per plant (12.1) , no. of seeds per pod (8.2) and yield (9.6 q ha^{-1}) of the urd crop with traditional method with PUSA Hydrogel @ 2.0 kg ha^{-1} is more than the traditional method (farmers practice) and during 2018-19, the no. of pods per plant (11.8), no. of seeds per pod (8.5) and yield was 9.5 q ha^{-1} which is also more in traditional method with PUSA Hydrogel. Similarly the Benefit: Cost ratio (B:C Ratio) in crop grown with PUSA Hydrogel was 1.18 during 2017-18 and 1.19 during 2018-19 as compare to in traditional method (farmers practice) which is 1.12 during the 2017-18 and 1.13 during 2018-19. The percent yield was increases in both the years as crop grown with PUSA Hydrogel.. Thus the technology of PUSA Hydrogel was found better in increasing production of the pulses under rainfed condition in hills of Uttarakhand.
KEYWORDS: *PUSA Hydrogel, On Farm Trial, B:C ratio*

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INTRODUCTION

Rainfed areas account for 68 per cent of India's net cultivated land and support about 360 million people. India ranks first among the rainfed agricultural countries of the world in terms of both extent and value of produce. Even after the realization of India's full irrigation potential by 2013, it is estimated that around 50 per cent of India's net cultivable area of 142 million ha will remain rainfed. But farming under rainfed conditions is quite risky because of its dependence on uncertain monsoon or rainfall and other limited inputs. More over majority of our farmers are small and marginal land holding. Further, it is very difficult for the farm families to get adequate food and income from agriculture alone for their sustenance. India is water stress and 52% cropped area remains without irrigation and some regions are chronically water stressed yet. Currently, irrigation consumes 84% of the water (industry 12% and households 4%). The shares of Uttarakhand in an agricultural in the country's total area and production is very small. The uttarakhnad state has 0.8

million ha of cultivated area constituting 16% of total geographical area. Over 55% of cultivated area is rainfed with frequent moisture stress to crops. The soils are low to medium in fertility status. The important crops are rice, wheat, finger millet and maize. Urd (*Vigna mungo L.*) is one of the important pulses crop grown across India as well as in Uttarakhand state. It is grown in adverse climatic condition and it has capacity to fix atmospheric nitrogen in the soil.

The farmers have very small and fragmented land holding. The average farm size being 0.6 to 0.8 ha, this is often subdivided into a number of plots in different locations. They measure their farm in *Nali* i.e. 1 ha is equal to 50 nali. It is estimated that only 10 to 11% of the hill cultivated land is irrigated which is mostly located at the bottom of the valleys, the rest are comes under rainfall. Generally farmers of the hills not use inorganic fertilizer (chemical fertilizers instead they rely on composting and farmyard manure (FYM) i.e. organic fertilizers to maintain the soil fertility. They also use crop residues in the fields. In this region the main thrust will be on promoting the adoption of improved varieties and hybrids of low water requiring crops like mandua, wheat, maize, other nutritious cereals, pulses and oilseed in conjunction with improved crop varieties and rain water harvesting practices, including life saving irrigation with stored rain water at critical stage of crop growth for maximizing productivity. At present, the total area and production of pulses in Uttarakhand is around 61000 ha and 51000 tonnes respectively [1] but the annual requirement of pulses in the state is 292,000 tonnes, leaving a vast deficit at the domestic level. This production scenario and increasing prices of pulses often result in protein mal-nutrition, especially among those living below the poverty line. Therefore, to reduce poverty and ensure food and nutritional security, it is essential to increase production of protein-rich pulses in the state. In order to achieve this, it is necessary to identify the problem of the hills, provide the better management practices, better varieties of the crops, promote and market a pulse crop that could grow well with minimum inputs in the fragile rainfed environments of the hills of Uttarakhand [2].

So keeping in mind for enhancement of the production of the pulses in the hills provide good variety of urd i.e. PU-31 which is bold seeded, short duration, tolerant to yellow mosaic virus (YMV) and also use one of the technology for in situ moisture conservation is PUSA Hydrogel which may prove as a practically convenient and economically feasible option to achieve the goal of agricultural productivity under conditions of water scarcity. It can be easily applied directly in the soil at the time of sowing of field crops and in the growth medium for nursery plantation. The low application rate (i.e. 2.5–5.0 kg/ha) of hydrogel is effective for almost all the crops in relation to soil type and climate of India **(3)**

PUSA HYDROGEL

PUSA Hydrogel is a granular product developed and patented by Indian Agriculture Research Institute (IARI) and being promoted by Indian Council for Agricultural Research (ICAR) as well as Ministry of Agriculture and Technology. The main function of this is it can absorb a minimum of 400 times of its dry weight of pure water and gradually release it according to the needs of the crop plant. It acts like a sponge and absorb water which is releases slowly to the crops to get a sustained supply of moisture as and when they need it. It enhances germination rate and improve physical properties of soil. Hydrogel are found to improve the physical properties of soils (viz. porosity, bulk density, water holding capacity, soil permeability, infiltration rate, etc.) It also increases biological/ microbial activities in the soil, which increase oxygen/air availability in root zone of the plant. The water held in root zone of the crop and leaching of nutrients in the soil are also reduced. So it increases 10-40% of the crop yield, 30-50% reduction in irrigation, 20-30% reduction in fertilizer and completely biodegradable and eco friendly.

MATERIAL AND METHODS

The On Farm Trial were conducted in farmers field covering 1 ha area with 10 farmers of a two villages of Tehri Garhwal district of Uttrakhand during the year 2017-18 and 2018-19 in kharif season in each year under rainfed condition. The soil was tested before the sowing of the crop in the KVK Soil Science lab. The soil was tested for pH, EC, OC, nitrogen, phosphorus, potassium, sulfur and some micronutrients.

Firstly the field was prepared and FYM was applied before 15-20 days of the sowing of the crop then crop was sown in the month of 1st week of july having the line to line spacing is

30 cm with 3-4 cm depth. The crop was grown in two treatments. In the first treatment it was grown simply with the traditional method (farmers practice) which is prevailing generally in the hills and in second treatment the crop was grown with application of PUSA Hydrogel along with traditional method. This paper describing the salient features of urd variety, discusses on farm performance of PUSA Hydrogel for moisture conservation along with its effect on the livelihoods of farmers. Details of On Farm Trial (OFT) conducted is given in table 1.

RESULT AND DISCUSSION

The soil sample results reveals that the soils of the fields was medium to high in fertility. The results in the 1st year during 2017-18 shows that the average no. of pods per plant, no. of seeds per pod and crop yield under the trial was 12.1, 8.2 and 9.6 q ha^{-1} respectively which was maximum in crop grown with PUSA Hydrogel (table 2). The economics of the trial was shown in table 3 and in the 2nd year 2018-19 the average no. of pods per plant, no. of seeds per pod and crop yield under the trial was 11.8, 8.9 and 9.5 q ha^{-1} respectively which was maximum in crop grown with PUSA Hydrogel also shown in table 2. The results also shows that the Benefit : Cost ratio (B:C) was 1.18 during 2017-18 and 1.19 during 2018-19 which was found maximum in crop grown with PUSA Hydrogel as compare to famers practice. The yield enhancement or percent increase in the yield due to technological interventions was 24.67 % during 2017-18 and 26.66% during 2018-19. The cost of cultivation was calculated on the basis of prevailing social, economical and prevailing micro climatic condition of that particular area.

Table 1. Details of On Farm Trial (OFT)

OFTs	OFT Title	Season	Name of Village/ Block	Treatments	Area
OFT-1	Effect of PUSA Hydrogel for moisture conservation in Urd crop	Kharif 2017-18	Maun village/ Narendra Nagar Block	T 1- Traditional method (Farmers practice) T2- Traditional method with PUSA Hydrogel	1 ha
OFT-2	Effect of PUSA Hydrogel for moisture conservation in Urd crop	Kharif 2018-19	Bour village/ Chamba Block	T 1- Traditional method (Farmers practice) T2- Traditional method with PUSA Hydrogel	1 ha

Table 2: Comparison of the parameters between traditional method (farmers practice) and traditional method with PUSA Hydrogel in Urd (Var. PU 31) under On Farm Trial (OFT)

Parameters	Traditional method (Farmers practice)		Traditional method with PUSA Hydrogel	
	2017-18	2018-19	2017-18	2018-19
No. of pods per plant	9.3	9.1	12.1	11.8
No. of seeds per pod	6.3	7.1	8.2	8.5
Yield (q ha^{-1})	7.7	7.5	9.6	9.5
Increase in yield (%)				24.67 26.66

Table 3: Comparison of the economics between traditional method (farmers practice) and traditional method with PUSA Hydrogel in Urd (Var. PU 31) under On Farm Trial (OFT)

Crop	Economics of Traditional method (Farmers practice)				Economics of Traditional method with PUSA Hydrogel			
	Gross Cost	Gross Income	Net Income	B:C Ratio	Gross Cost	Gross Income	Net Income	B:C Ratio
Urd (PU-31) 2017-18	29000	32585	3585	1.12	29000	34415	5415	1.18
Urd (PU-31) 2018-19	30000	33900	3900	1.13	30000	35950	5950	1.19

CONCLUSION

It can be concluded that use of PUSA Hydrogel is increase the no. of pods per plant, no. of seeds per pod and yield of the urd crop variety PU-31 and it is quite effective under rainfed condition which gave 24.67% and 26.66% during 2017-18 and 2018-19 respectively increased yield of urd. The B:C Ratio was 1.18 and 1.19 during 2017-18 and 2018-19 respectively with PUSA hydrogel which was highest as compare to Farmers practices. Thus recommended to pulses growers for increasing income per unit area, reduced the number of irrigation and increased the plant growth. Farmers appreciated this technology to enhance the production of pulses. But not only this, farmers should have manage their crop scientifically. Hence hydrogels may become a practically convenient and economically feasible option in water-stressed areas for increasing agricultural productivity with environmental sustainability. Special attention will be paid to educate and empower the farmers about adopting critical practices like fertilizer application to the crop immediately after a rainfall event in early stages of crop growth. These efforts will surely help in improving household food security.

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