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Productivity and profitability of common bean (*Phaseolus vulgaris* L.) under varying organic nutrients and non-chemical weed management practices in Kashmir valley

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Abstract
This study examined the effects of organic nutrients and non-chemical weed control techniques on the productivity, and profitability of common bean (*Phaseolus vulgaris* L.) during the 2021 and 2022 growing seasons at the crop research farm of the Agronomy, Faculty of Agriculture, Wadura, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir. Regardless of non-chemical weed management practices, up to till the crop harvest, weed free was as control treatment. In both years, common bean was sown on the first week of June and split plot design was used with three replications, four treatments in main plot and then distributed six treatments in sub-plots. Combining statistical data from both seasons, seed yield and biological yield were significantly different from control. However, VC (1 t ha^{-1}) showed the highest values in yield parameters, these parameters were generally equal under FYM (6 t ha^{-1}), and FYM +VC (3 t ha^{-1} + 0.5 t ha^{-1}) treatments, though. Different kinds of mulching had a considerable impact on weed management practices. In both years, the VC (1 t ha^{-1}) and WF treatments had the highest relative economic value.

Keywords: Nutrient sources, weed, management, crop, yield

Introduction
The common bean (*Phaseolus vulgaris* L.) is one of the most important pulses grown and widely consumed for its edible vegetables, shelled green beans, and dry beans in many countries around the world. It is a legume of utmost importance and usefulness to human beings everywhere, providing food and feed for animals. Because of its significant high quality for protein, energy, fibre, and micronutrients, particularly iron, zinc, and pro-vitamin A; and because it has the ability to prevent diseases and contain health-promoting compounds, it is referred to as the "grain of hope" for the poor (Sarma, 2014) [15]. In India, it is also known as local namely Rajmash (Sheikh *et al*., 2014) [16]. With the increase in human population the world-wide, there is a greater need for food crops suited to the harmful, thus puts legumes into such a huge demand, which includes mostly the common bean among pulses. The annual world common bean production has been estimated about 31.8 MT and it accounts for 41.3% of global pulses production and it has 50.37% of the total land used for global pulses production. In India, it is sown area 9.47 M ha during the two season of the Kharif and rabi with a production of 3.8 MT and productivity of 0.41 t ha^{-1} (FAOSTAT, 2016; 2019) [3, 4] And it is primarily grown the different states of India viz; Maharashtra, Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh, Tamil Nadu (Nilgiri Hills, Palani Hills), Kerala (Parts of Western Ghats), Karnataka (Chickmagalur Hills) and West Bengal (Darjeeling Hills). In the districts of Baramulla, Bandipora, and Kupwara under the state of Jammu and Kashmir, pulses is mostly planted in rainfed areas, either as a mono crop or as an intercrop with maize using minimum inputs, leading to low yields (Sheikh *et al.*, 2014; 2017) [16, 17]. India can achieve self-sufficiency in agricultural production by using more inorganic fertilizers over the long term without adding organic supplements, but these can harm the environment and result in agrochemical residues that are harmful to people and other living things through food and feed products as well as soil profiles through the deterioration in soil chemical, physical, and biological properties and leading to reducing not only nutritive value of crop but also soil

profiles in agricultural land with fulfill of soil organic matter, soil biota and nutrients (Sarma, 2014; Singh *et al.* 2004) [15, 20]. For the agricultural productivity and sustainability, it is crucial to minimize the usage of chemical fertilizers while increasing organic nutrient sources used. The biggest problem in crop production is weed which severely compete with the crop of interest for resources like light, water, and nutrients. Weed also serve as hosts for many diseases and insects, which drastically reduces the economic yield and the farmer's income. The percent of thirty three of India's agricultural losses are due to weed infestation, and crop growers widely use chemical herbicides to control weeds in crop production. Despite these herbicides are very effective for weed control management, however their residual effects in soil, water and air raises serious concerns because of their long-term using on ecosystem of crop producing land. Organic weed management practices do not present such problems and also effective at controlling weeds (Lal *et al.* 2016) [7]. Therefore, non-chemical weed management practices are essential to preventing weeds from negatively impacting on the crop productivity. Black polythene sheets and natural materials, such as brown sarsen residues, are the most helpful as mulching materials that cover soil, conserve soil moisture content, and reduce erosion factors (soil, water, and wind), in crop production (Rana and Rana, 2016) [8]. These mulches have several advantages over synthetic products and profitable crop cultivation (Kwambe *et al.* 2015) [6]. In the Kashmir valley, this study examined the effect on productivity and profitability of common bean (*Phaseolus vulgaris* L.) with organic nutrients source and non-chemical weed management practices.

Materials and Methods

During the two years of the cropping season of 2021 and 2022, the experiment was conduct at the Agronomy Farm, Faculty of Agriculture, Wadura, Sopore, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir (SKUAST-K) University, and Kashmir. A split plot design was used with consisted of two components and three replications. There were four treatments of organic nutrient sources in main plot viz; VC, vermicompost (1 t ha^{-1}), FYM, farmyard manure (6 t ha^{-1}), FYM + VC (3 t ha^{-1} + 0.5 t ha^{-1}) and control along with six treatments of non-chemical weed management practices in sub-plot viz; brown sarsen mulching (BSR), black polythene sheet (BPS), manually weeding (MW), weed mulching (WM), weedy check (WC) and weed free (WF). There were a total of seventy two plots combinations with each sub-plot having area of 4m × 2.4 m and a gross main plot area of 38m x 26.5m by 0.75m foot paths.

Application of Organic Nutrient Sources and Mulching

Eight kilogram of FYM (100 kg), containing 0.5% nitrogen, and four kilogram of VC, containing 3%, were utilized in each main plot that was allotted, and then another main plot received FYM (4kg) + VC (2kg) treatment. VC and FYM were added to incorporate consistently in the main plots before 15 days before sowing of common bean. By using non-chemical weed management practices, brown sarsen residue at the recommended rate of 2.5 t ha^{-1} and weed mulching for each sub-plot in each main plot was mulched after germination, while black polythene sheet (25 micron) was covered, and a sessions was then used to open the furrow and allow easily germinated seeds to emerge. Two times at 20 and 40 DAS and four times at 20, 30, 40, and 50 DAS, respectively, were spent for manually weeding (MW) and weed free (WF) treatments.

Data Analysis: The obtained data for numerous observations was statistically examined by using Cochran and Cox technique (1936). The significant level for F and t was set at 5%.

Results and Discussions

Seed Yield (t ha^{-1}): The main effect of the nutrient source had a significant impact on crop yield during the first two seasons of the study, as shown in Table-4. After that, the highest seed yield (1.4 t ha^{-1}) was reportedly found in VC (1 t ha^{-1}) treatment, but statistically pooled data showed that it was equal to the treatments of FYM (6 t ha^{-1}), FYM + VC (3 t ha^{-1} + 0.5 t ha^{-1} in the years 2021 and 2022, respectively, though (Table-1). However, compared to the control (C) treatment, a considerable increase in seed yield was observed. The regardless of weed management practices, the greatest mean of seed yield (1.4 t ha^{-1}) was found under weed free (WF), followed by BPS, MW, BSR, and WM among treatments. The same trend is reached by Singh and Chauhan (2009) [19], Abd El-Hady *et al.* 2014 [1], Sahariar *et al.* (2015) [13], Sadeghipour, O. (2017) [14], Uddin *et al.* (2018) [12], and Oimbo *et al.* (2018) [22], Parween (2019) [10] and Baker *et al.* (2021) [2].

Biological Yield (t ha^{-1}): The data (Table-1) indicated that there were significant different between the nutrient source treatments compared to control (C) treatment in both years and it also showed that VC (1 t ha^{-1}) treatment had the highest biological yield values (3.6 t ha^{-1}), it is at par with FYM (6 t ha^{-1}) and with FYM (6 t ha^{-1}) and FYM + V (3 t ha^{-1} + 0.5 t ha^{-1}), in 2021 and 2022, respectively. The biological yield varied significantly across different weed management practices had significant in each treatment during two years of investigation and weed free (WF) treatment showed that the highest value of biological yield (3.7 t ha^{-1}) than the other treatments and the lowest biological yield was observed under the weedy check (WC) in both of years. The outcome may be attributable due to the effect of the organic nutrient source and non-chemical weed management practices have increased the yield parameters (Kwambe *et al.* 2015, Shiferaw and Osman, 2017 and Yimamu, 2020) [6, 18, 21].

Relative Economic: The maximum cost of cultivation was estimated with treatment VC and WF (Table-5). The treatments of the applied nutrient source and weed management practices affected the gross income, net income and benefit: cost (B:C) ratio VC along with weed free generated relatively greater gross income and benefit: cost (B: C) ratio in the two years of study. However, the data indicated that the maximum net income was higher in FYM (6 t ha^{-1}) with WF and in VC (1 t ha^{-1}) along with WF during 2021 and 2022 year, respectively. These results are in agreement with those reported by Kamal *et al.* (2010) [5] and Priyadharshini *et al.* (2021) [11].

Table 1: Yield parameters on common bean as influenced by nutrient sources and weed management for 2021 and 2022

	2021		2022	
	Seed yield (t ha^{-1})	**Biological yield (t ha^{-1})**	**Seed yield (t ha^{-1})**	**Biological yield (t ha^{-1})**
Source of nutrient (N)				
FYM	1.3	3.5	1.6	4.1
VC	1.4	3.6	1.7	4.2
FYM+VC	1.3	3.3	1.6	4.0
Control	1.1	3.1	1.4	3.8
S.E (m) (±)	0.03	0.05	0.02	0.05
CD (p≤0.05)	0.09	0.17	0.07	0.18
Weed management (W)				
BSR	1.3	3.4	1.5	3.9
BPS	1.4	3.6	1.9	4.7
MW	1.3	3.4	1.6	3.9
WM	1.2	3.2	1.4	3.6
WC	1.0	2.9	1.1	3.1
WF	1.4	3.7	2.0	4.9
S.E (m) (±)	0.03	0.05	0.03	0.06
CD (p≤0.05)	0.09	0.15	0.10	0.18

Table 2: Relative economic (₹ ha^{-1}) of common bean as influenced by nutrient source and weed management for 2021 and 2022

Treatments	**Cost of Cultivation**		**Gross Income**		**Net Income**		**B:C**	
Nutrient source (N)	2021	2022	2021	2022	2021	2022	2021	2022
FYM	59454	52818	132248	159273	77299	98805	1.23	1.74
VC	63949	66818	137662	165623	73156	106455	1.41	2.00
FYM+VC	54949	62268	128565	157555	69115	95237	1.22	1.52
Control	48949	51818	108866	142461	59917	90643	1.16	1.47
S.E (m) (+)	610	637	1596	1443	57119	1443	0.00	0.01
CD (p≤0.05)	2109	2204	5522	4995	NS	4995	0.00	0.04
Weed management (W)								
BSR	55549	57826	129015	149045	72366	91219	1.23	1.60
BPS	58132	57751	136796	187380	80555	129795	1.39	2.04
MW	58124	57826	129466	155213	72366	97387	1.32	1.72
WM	55399	57276	117794	139598	60591	81772	1.10	1.43
WC	53124	55076	103809	108759	49764	53682	1.00	1.00
WF	60624	64826	144127	197374	83587	132856	1.49	2.30
S.E (m) (+)	613	782	2125	1768	2594	1768	0.00	0.02
CD (p≤0.05)	1752	2235	6073	5053	7414	5053	0.00	0.05

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