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Nutrient Management through Organics in Pea - Buckwheat Cropping System under Dry Temperate Conditions of North Western Himalayas

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***Abstract:** In the dry temperate region, growing of a single crop in a year is a common feature of cropping. The shrinking of per capita land availability further warrants temporal and spatial intensification of cropping. Therefore, pea-buckwheat has been evolved as one of the potential cropping sequences in the temperate region. The present study focuses on organic nutrient management in peas and subsequent residual activity on common buckwheat. Vermicompost at 3.0 and 4.5 t/ha, FYM 20 t/ha, Vermicompost 1.50 t/ha + FYM 10 t/ha and vermicompost 3.0 t/ha + FYM 3.0 t/ha were compared to recommended application of NPK (20:60:30 kg N, P_2O_5 and K_2O in peas only) and control (no fertilizer). In buckwheat, only the residuals of the treatments were studied. During the first year, inorganic nutrient management treatment resulted in significantly higher pods/plant, seeds/pod, green pea yield, pea equivalent yield, gross and net returns and B:C over the organic nutrient management treatments. However, in the second year, organic nutrient management treatments gave higher yield of peas, pea equivalent yield and gross returns over the organics. Organic nutrient management treatments involving vermicompost in general were superior to inorganics in influencing branches/plant, seeds/plant and seed yield of buckwheat during both the years. Vermicompost 4.5 t/ha was comparable to vermicompost 1.5 t/ha + FYM 10 t/ha and vermicompost 3.0 t/ha + FYM 10 t/ha for the yield attributes and yield of peas and buckwheat, green pea equivalent yield, gross and net returns and B:C.*

***Key words:** Pea – buckwheat sequence, yield attributes, yield, economics*

INTRODUCTION

In dry temperate regions of North Western Himalayas crop cultivation is feasible during summer (April- September) only, and one crop in a season is a common feature of cropping. The cultivated lands are being further reduced due to developmental activities to meet out modern amenities for the increasing population. The progressive shrinking of per capita land availability warrants temporal and spatial intensification of cropping. After 1980's by replacing traditional crops, pea became one of the major cash crops in dry temperate region of North Western Himalayas (Rana et al 2003a). The development of short duration and input responsive varieties of pea, have opened up new avenues since buckwheat could be grown in quick succession. Pea being a leguminous crop is capable of fixing atmospheric nitrogen and leaving sufficient residual amount in the soil (Orlov and Knyazeva 1977 and Rana *et al*. 2003a). The succeeding crop, therefore, can utilize these nutrients. Until recently buckwheat has been regarded as a crop of poor fertility soils (Rana *et al*. 2003b). The recent discovery that the buckwheat plant is likely to have its own potential for nitrogen production through nitrogen fixing bacteria (Lokova 1998, Alekseyeva 2002) shows that it may play a vital role in sustainable crop production. In the recent past pea-buckwheat has been evolved as an important cropping system in the dry temperate conditions of north-western Himalayas (Rana et al 2003; Rana et al 2006; Sharma et al 2015; Kumar et al 2015). A little work on nutrient management in pea-buckwheat cropping system has also been done (Rana et al 2003; Sharma et al 2015). The present study focuses on organic nutrient management in pea - buckwheat cropping system for sustainable productivity under dry temperate conditions of North-western Himalayas, since organic farming has gained momentum in the recent past.

MATERIALS AND METHODS

A field experiment was conducted in a permanent layout for two consecutive summer seasons (2010 and 2011) at Highland Research and Extension Centre, Kukumseri to evolve general recommendation for organic nutrient management in pea – buckwheat cropping system in dry temperate region of North-western Himalayas. Vermicompost at 3.0 and 4.5 t/ha, FYM 20 t/ha, Vermicompost 1.50 t/ha + FYM 10 t/ha and vermicompost 3.0 t/ha + FYM 3.0 t/ha were compared to recommended application of NPK (20:60:30 in peas; and residuals in buckwheat) and control (no fertilizer) (Table 1) in randomized block design with three replications. The peas cv. Azad P-1 was sown on 29 April and 20 May and harvested on 14 July and 27 July during 2010 and 2011, respectively. The subsequent crop buckwheat cv. Local was sown on 27 July and 28 July and harvested on 19 October and 28 October during 2010 and 2011, respectively. The soil of the experimental field was sandy loam in texture, with organic matter content of 0.62% and pH 6.8. The soil had available 190, 39 and 156 kg/ha of N, P and K, respectively. Except fertility treatments, both crops were sown with recommended package of practices under irrigated condition (CSKHPKV, 2007). Snow-melt water, the only source of irrigation was used to irrigate crops through sprinklers, rain gun or *Kuhl*. The rest of the management practices were in accordance with the recommended package of practices for the individual crops. The crops were harvested from net plot. Green pod yields were obtained in three pickings. For comparison between treatments, the economic yields of crops were converted into pea equivalent on price basis. Land utilization efficiency was worked out by summation of duration of each crop under individual crop sequence divided by 365. Production efficiency (kg/ha/day) was obtained by dividing total production in terms of pea equivalent in a sequence by the total duration of year (365), while profitability (INR/ha/day) was obtained by dividing net monetary return by 365. Economics of treatments was computed based on prevalent prices.

RESULTS and DISCUSSION

Yield attributes and yield of peas

The data on yield attributes and yield of peas are summarized in Table 1. The data reveal significant superiority of fertility treatments over control in influencing pods/plant, seeds/pod and green pod yield during both the years. During the first year, inorganic nutrient management treatment resulted in significantly higher pods/plant, seeds/pod and thereby green pod yield over the organics. However, in the second year organic nutrient management treatments except vermicompost 3.0 t/ha and FYM 20 t/ha gave higher yield attributes and yield over the inorganic nutrient management treatment. Vermicompost 3 t/ha and FYM 20 t/ha were statistically at par to inorganic nutrient management treatment in influencing yield attributes and yield of pea during the second year. The residual toxicity of inorganics have been reported earlier in pea-buckwheat cropping system (Rana et al 2003a). Vermicompost appeared to have an edge over FYM. Vermicompost 4.5 t/ha was comparable to vermicompost 1.5 t/ha + FYM 10 t/ha and vermicompost 3.0 t/ha + FYM 10 t/ha for the yield attributes and yield of peas. The superiority of these treatments may be attributed to the stimulating effect of organics on growth and activities of microorganisms. On an average, inorganic nutrient management treatment, vermicompost 3.0 t/ha + FYM 10 t/ha, vermicompost 1.5 t/ha + FYM 10 t/ha and vermicompost 4.5 t/ha increased green pod yield of peas by 118.2, 116.1, 98.9 and 115.7%, respectively, over control.

Yield attributes and yield of buckwheat

Fertility treatments brought about significant variation in yield attributes and yield of buckwheat Table 2). All treatments except FYM 20 t/ha were significantly superior to control in influencing branches/plant and seeds/plant. These were reflected in yield of buckwheat. Except FYM 20 t/ha during 2010, other fertility treatments significantly increased seed yield of buckwheat over control. Organic nutrient management treatments involving vermicompost in general were superior to inorganics in influencing branches/plant, seeds/plant and thereby seed yield of buckwheat. These findings clearly indicated the stimulating effect of organics especially vermicompost on the growth of buckwheat through the activities of microbes in the soil. On an average buckwheat seed yield under FYM 20 t/ha, vermicompost 3.0 t/ha, vermicompost 4.5 t/ha, vermicompost 1.5 t/ha + FYM 10 t/ha, vermicompost 3 t/ha + FYM 10 t/ha and inorganic nutrient management treatment was 26.3, 79.6, 95.4, 94.4, 100.6 and 40.9% higher over control. Yield of buckwheat under inorganics was 78.4, 72.1, 72.5 and 70.2% of that under Vermicompost 3t/ha, vermicompost 4.5 t/ha, vermicompost 1.5 t/ha + FYM 10 t/ha and vermicompost 3.0 t/ha + FYM 10 t/ha, respectively. Thus vermicompost alone or in combination with FYM applied only in pea can be effective nutrient management alternative in buckwheat production in pea-buckwheat cropping system.

Green pea equivalent yield

Due to increase in individual crop yield, the fertility treatments had significant superiority over control in influencing the green pod equivalent yield during both the years. During the first year, inorganic nutrient management treatment resulted in significantly higher green pod equivalent yield over the organics. However, in the second year all organic nutrient management treatments gave higher green pea equivalent yield over the inorganic nutrient management treatments. Vermicompost 3 t/ha and FYM 20 t/ha were statistically at par with each other in influencing green pea equivalent yield during both the years but had lower pea equivalent yield than other organic nutrient management treatments. Vermicompost had an edge over FYM initially because of readily availability of nutrients. In the second year, FYM had an advantage over vermicompost because of having more carryover of nutrients. Vermicompost 4.5 t/ha being comparable to vermicompost 1.5 t/ha + FYM 10 t/ha and vermicompost 3.0 t/ha + FYM 10 t/ha gave significantly higher green pea equivalent yield over other treatments. The superiority of these treatments may be attributed to the stimulating effect of organics on growth and activities of microorganisms. On an average, inorganic nutrient management treatment, vermicompost 3.0 t/ha + FYM 10 t/ha, vermicompost 1.5 t/ha + FYM 10 t/ha and vermicompost 4.5 t/ha increased green pod equivalent yield by 114.0, 115.2, 98.6 and 114.6%, respectively, over control.

Economics

Due to higher crop yield, the fertility treatments were significantly superior to control in influencing gross and net return during both the years. During the first year, inorganic nutrient management treatment resulted in significantly higher gross and net return over the organics. However, in the second year all organic nutrient management treatments gave higher gross and return over the inorganic nutrient management treatments. Vermicompost 4.5 t/ha was comparable to vermicompost 1.5 t/ha + FYM 10 t/ha and vermicompost 3.0 t/ha + FYM 10 t/ha for the gross return. On an average, inorganic nutrient management treatment, vermicompost 3.0 t/ha + FYM 10 t/ha, vermicompost 1.5 t/ha + FYM 10 t/ha and vermicompost 4.5 t/ha increased gross return by 113.0, 115.9, 99.6 and 115.4%, respectively, over control. The corresponding increase in net return under these treatments was 228.1, 198.4, 171.9 and 217.1%, respectively. Vermicompost 3 t/ha and FYM 20 t/ha were statistically at par with each other in influencing gross and return during both the years.

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Table 1. Effect of fertility treatments on yield attributes and yield of pea in pea-buckwheat cropping system

Treatment	Pods /plant		Seeds /pod		Seed weight/pod		Green pod/ha		
	2010	2011	2010	2011	2010	2011	2010	2011	Mean
Vermicompost 3.0 t/ha	4.19	3.25	4.45	3.2	2.88	2.86	4508	2847	3678
Vermicompost 4.5 t/ha	5.62	4.43	5.06	4.25	2.83	2.81	6198	4917	5558
FYM 20 t/ha	3.83	3.93	4.05	3.17	2.84	2.79	4386	3042	3714
Vermicompost 1.5 t + FYM 10 t/ha	4.76	4.66	4.35	4.56	2.77	2.77	5497	4750	5124
Vermicompost 3.0 t + FYM 10 t/ha	5.52	4.41	5.13	4.71	2.69	2.87	6315	4819	5567
Recommended NPK	6.18	3.37	5.45	3.46	2.78	2.79	7953	3291	5622
Control	3.11	2.74	3.33	3.03	2.74	2.75	3216	1937	2577
LSD (P=0.05)	0.38	0.72	0.24	0.63	NS	NS	520	793	-

Table 2. Effect of fertility treatments on yield attributes and yield of buckwheat in pea-buckwheat cropping system

Treatment	Branches/plant		Seeds /plant		1000-seed weight (g)		Seed yield (kg/ha)		
	2010	2011	2010	2011	2010	2011	2010	2011	Mean
Vermicompost 3.0 t/ha	5.45	4.39	66.42	52.03	1.082	0.971	339	241	290
Vermicompost 4.5 t/ha	6.03	4.43	70.36	52.64	1.066	0.911	368	263	316
FYM 20 t/ha	3.51	3.53	58.03	47.03	1.097	0.956	222	186	204
Vermicompost 1.5 t + FYM 10 t/ha	5.62	4.46	66.28	52.96	1.036	0.881	357	271	314
Vermicompost 3.0 t + FYM 10 t/ha	6.16	4.38	71.36	54.33	1.050	0.953	386	262	324
Recommended NPK	3.75	4.11	55.21	48.14	1.029	0.936	240	215	228
Control	2.95	3.11	49.49	45.21	1.077	0.914	187	136	162
LSD (P=0.05)	0.92	0.50	3.48	4.56	NS	NS	53	22	

Table 3. Effect of fertility treatments on peas equivalent yield and economics

Treatment	Pea equivalent yield (kg/ha)			Gross return (INR/ha)			Cost of cultivation (INR/ha)	Net return (INR/ha)			B:C ratio		
	2010	2011	Mean	2010	2011	Mean		2010	2011	Mean	2010	2011	Mean
Vermicompost 3.0 t/ha	4815	3067	3941	154087	104269	129178	52272	102246	51565	76906	1.97	0.98	1.47
Vermicompost 4.5 t/ha	6532	5157	5844	209008	175331	192170	55377	154107	119477	136792	2.81	2.14	2.47
FYM 20 t/ha	4587	3212	3899	146790	109194	127992	69262	78269	39190	58730	1.14	0.56	0.85
Vermicompost 1.5 t + FYM 10 t/ha	5821	4997	5409	186257	169901	178079	60767	126076	108547	117312	2.09	1.77	1.93
Vermicompost 3.0 t + FYM 10 t/ha	6665	5058	5861	213274	171968	192621	63872	150033	107464	128749	2.37	1.67	2.02
Recommended NPK	8171	3487	5829	261456	118559	190008	48442	213355	69775	141565	4.44	1.43	2.92
Control	3385	2061	2723	108335	70074	89205	46062	62614	23670	43142	1.37	0.51	0.94
LSD (P=0.05)	568	813		18177	27644			18177	27644				

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