International Journal of Latest Engineering and Management Research (IJLEMR)
ISSN: 2455-4847
www.ijlemr.com || Volume 03 - Issue 02 || February 2018 || PP. 50-53

Effect of *BD-501* and *Panchagavya* on Yield and Quality of Garden Pea cv. Arkel

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Abstract: Chhotanagpur plateau of Eastern India often considered as vegetable bowl of the region due mainly to its suitable agro-climatic conditions for growing several seasonal vegetables throughout the year. Garden pea is one of the most important winter vegetables of the area grown extensively in Ranchi, Ramgarh, Hazaribagh and Palamau districts of Jharkhand through conventional chemical farming practices. The recent study perceived residues of some toxic agro-chemicals in samples of different vegetables collected from Ranchi and surrounding areas. In addition, the financial condition of small and marginal farmers' especially tribal farmers of the region is too worst to cope up with high cost involving chemical farming. It has also been revealed that organic and biodynamic farming practices have the potential to harvest quality produce from different crops. Keeping view in mind, an attempt has been taken to conduct a field experiment during *rabi* season of 2016-17 at the organic experimental farm of F/C: IRTDM, Ranchi of Ramakrishna Mission Vivekananda Educational and Research Institute to observe the influence of different concentrations of *BD-501* and *Panchagavya* on yield and quality of Garden Pea cv. Arkel. The experiment was designed after CRBD with three replications and eight treatments *viz.*, T_1 = *BD-501* (2%); T_2 = *BD-501* (5%); T_3 = *BD-501* (10%); T_4 = *Panchagavya* (3%); T_5 = *BD-501* (2%)+*Panchagavya* (3%); T_6 = *BD-501* (5%)+*Panchagavya* (3%) ; T_7 = *BD-501* (10%)+*Panchagavya* (3%) and T_8 = Control [without any biodynamic or organic input]. These treatments combinations wererandomly distributed in 24 experimental plots each of with 2.40 m x 2.0 m size where garden pea cv. Arkel was grown at 30 cm x 20 cm spacing. The investigation encompassed basal application of organic manure in the form of FYM @ 10 $t.ha^{-1}$ along with four times [first at 3 weeks after sowing and thereafter thrice at 15 days interval] split application of *BD-501* and *Panchagavya* as per the treatments. Almost all the studied yield and quality parameters were highly influenced either by sole application of *BD-501*/*Panchagavya*or with the application of their combined formulations as per the specified treatments. In this context, T_5 [*BD-501* (2%)+*Panchagavya* (3%)] emerged as the best treatment where maximum green pod yield of 15.56 $t.ha^{-1}$ was recorded beside the good quality pods with higher ascorbic acid (220.00 $mg.100g^{-1}$ fresh edible seed) and moderate seed protein (16.25%) followed by T_6 [*BD-501* (5%)+*Panchagavya* (3%)] with 14.63 $t.ha^{-1}$ green pod yield through 183.00 $mg.100g^{-1}$ and 14.74% of ascorbic acid and protein in edible seeds, respectively as against the lowest values in almost all aspects except ascorbic acid as recorded in T_8 [green pod yield: 10.17 $t.ha^{-1}$; ascorbic acid: 153.00 $mg.100g^{-1}$ (5^{th} position) and seed protein: 10.75%]. From the finding, it may be concluded that combined application of *BD-501*and *Panchagavya* has positive effects over yield and quality of garden pea. In this perspective, *BD-501* with its lower concentration (2-5%) and *Panchagavya* (3%) appeared with their good effects over yield and quality attributes of garden pea. Hence, the technology may be recommended for commercial scale quality production of the crop in Chhotanagpur region of Jharkhand of the Eastern Indian plateau.

Keywords: Garden Pea, *Pisumsativum*, Arkel, *BD-501*, *Panchagavya*, Yield, Protein, Ascorbic Acid

I. Introduction

Garden pea (*Pisumsativum* L.) is a popular winter vegetable legume of the family Fabaceae. It is commonly used in the human diet as a vegetable because of its richness in protein (21-25%) with high levels of amino acids, especially lysine and tryptophan (Bhat*et al*., 2013; Hillocks *et al.*, 2000; Vaughan and Geissler, 1997). Ethiopia, the Mediterranean region, and Central Asia are considered as primary centers of origin of *Pisumsativum*with a secondary center of diversity in the Near East (Vavilov, 1949). China, India, USA, France, Egypt, UK, Pakistan, Algeria, Peru, Turkey, Russian Federation, and Italy are major producers of the vegetable pea of the world (FAO, 2016). As per 2016 data, garden pea contributed about 32.09 million tonnes of production from its 4.11 million hectares of global land, whereas, India produced 4814.00 thousand metric tonnes from only 497.00 thousand hectares of land and occupied the 2^{nd} position in the global production of garden pea (just after China) with the production share of 15.00% from only 12.09% area(FAO, 2016). Jharkhand has a remarkable share of garden pea production with 24.38 thousand hectare under cultivation and about 362.84 thousand tonnes of production and the productivity of the crop in the state is quite higher (14.88

t.ha^{-1}) than the national average (9.45 t.ha^{-1}) as per 2014-15 production data (HSD, DAC & FW, 2016). Ranchi, Gumla, Hazaribagh, Ramgarh, Lohardega, East Singhbhum, Chatra, Koderma, Giridih, Dhanbad, Bokaro, Pakur, Palamau and Dumka are important districts of Jharkhand where garden pea is grown commercially. However chemical fertilizers are generally recommended for growing the crop with higher level of production but their overuse has hardened the soil, decreased fertility status of cultivated land, reinforced pesticides, polluted air and water, and released greenhouse gases, and ultimately becoming hazardous to human health and the environment as well.Alternative and sustainable approaches of farming practices, on the contrary, can overcome such complications without reducing the yield potential of the crop.

Biodynamics farming is as common with other organic approaches thataccentuates the use of manures and composts and discourages the use of synthetic chemicals on soil and plants. Methods unique to the *biodynamic* approach include its treatment on crops, and soil as a single ecosystemby adopting an astronomical sowing and planting calendar (Turinek*et al.,* 2009). Likewise, the miraculous combination of five '*gavya*' (five products obtained from cow) traditionally known as '*Panchagavya*' tremendously helps to enhance the biological efficiency and quality of various species of crop plants. *Panchagavya* contains five products from cow *viz*., milk, curd, ghee, dung and urine. Milk contains some valuable micronutrients, carotenoids, flavones, phenolic compounds, steroids, vitamins and several compounds. In this context, *Panchagavya* is considered to be highly effective liquid organic manure for successful crop production cycles. It has multifarious functions which can effectively be replaced chemical fertilizers and pesticides. *Panchagavya* helps to preserve the quality of crops, soil and environment as well. It has also been revealed that as compared to chemical fertilizers, *Panchagavya* is less expensive and more ecofriendly with no side effects (Biswas and Pait, 2015).

Based on the above valuable information on *Biodynamics* and *Panchagavya* over the growth, development as well as positive effects on yield and quality attributes of several crops, the present study has been conducted with highlighting on the following specific objectives:

- ✓ To study the effect of biodynamic and organic inputs over the yield and associated characters of garden pea
- ✓ To understand the effect of such biodynamic and organic liquid formulations over the expression of quality contributing attributes of the crop.

II. Materials and Methodology

The present experiment was conducted during *rabi season of* 2016-17 at the organic experimental farm of F/C: IRTDM, Ranchi of Ramakrishna Mission Vivekananda Educational and Research Institute to observe the influence of different concentrations of *BD-501* and *Panchagavya* on yield and quality of Garden Pea cv. Arkel. The experiment was designed after CRBD with three replications of eight different treatments *viz.*, T_1 = *BD-501* (2%); T_2 = *BD-501* (5%); T_3 = *BD-501* (10%); T_4 = *Panchagavya* (3%); T_5 = *BD-501* (2%)+*Panchagavya* (3%); T_6 = *BD-501* (5%)+*Panchagavya* (3%) ; T_7 = *BD-501* (10%) +*Panchagavya* (3%) and T_8 = Control [without any biodynamic or organic input]. Treatment combinations were allocated in 24 experimental plots each of with 2.40 m x 2.00 m size. Seeds of the experimental crop variety were sown during *rabi*season following 30 cm inter row and 20 cm intra row spacing. The current investigation comprehendedwith the basal application of organic manure in the form of FYM @ 10 t.ha^{-1} along with four times [first at 3 weeks after sowing and thereafter thrice at 15 days interval] split application of *BD-501* and *Panchagavya* as per the treatments. *BD-501*was prepared by pouring cow horn with silica powder and then the silica powder filled cow horns were buried in the pit during descending period of the moon in March-April. After six months of incubation, horns were taken out in October-November during the ascending period of the moon. Finally, light yellowish silica powder was taken out from the horn and stored in light near window side in glass jars and the silica powder thus obtained has 100% of its strength. *Panchagavya*was prepared by mixing cow dung, cow urine, milk, curd and ghee @ 5:3:2:2:1 proportion andincubated the mixture for 9 days in a wide mouth plastic container.Finally, the formulation (*Panchagavya*)thus obtained also has 100% of its strength. The required concentrations of treatment inputs were prepared by using the formula, $V_1S_1 = V_2S_2$, where 'V' and 'S' represent the volume and strength of the treatment solution, respectively.Different yield attributes of the crop *viz.* days to 50% flowering, days taken to 1st pod harvest, plant height (cm), number of pods.plant^{-1}, pod length (cm), number of seeds.pod^{-1}, and green pod yield (t.ha^{-1}) were taken into consideration for the study, at the same time, several quality traits like ascorbic acid (mg.100g^{-1}) [Titrimetric method], total sugar (%) [Lane and Eynon method] and protein (%) [Kjeldahl method] were estimated from the edible portion of pods by following standard analytical methodologies. Data thus obtained were subjected to analyses through standard statistical tools for their interpretations and preparation of the manuscript.

III. Results and Discussion

Yield and its associated attributes performed independently under the influences of *BD-501*, *Panchagavya* or in combination of these two. However, the results showed that the combination of *BD-501*and *Panchagavya* with their lower concentrations (2% and 3%, respectively) performed significantly well (**Table1**).In this context, T_5 [*BD-501* (2%)+*Panchagavya* (3%)] emerged as the best treatment with maximum green pod yield (15.56 $t.ha^{-1}$) as contrast to the lowest green pod yield (10.17 $t.ha^{-1}$) as recorded in the case of T_8 treatment where no input was applied. Such observation is obvious because the *biodynamic* and organic liquid input (here, *Panchagavya*) provided the nutrients to the crop for its proper growth and development with the culmination of higher yield in different treatments rather than control treatment. The present findings over yield and its associated traits closely matched with the previous observations of Reddy *et al.* (1998); Asghar*et al.* (2003); Negi*et al.* (2006); Susheela *et al.* (2007); Rather *et al.* (2010); Jitender (2011); Mishra (2014). Similarly, quality contributing parameterswere also performed well in the case of T_5 treatment and as a consequence, higher level of ascorbic acid (220.00 $mg.100g^{-1}$) coupled with the more total sugar (13.33%) and seed protein (16.25%) were estimated from the samples derived from the T_5 treatment. As per the expectation, control treatment (T_8)once again recorded lower level of total sugar (7.96%) and protein (10.25%) but it was also found that the sample collected from the control treatment delimitedwith the significant amount of ascorbic acid (153.00 $mg.100g^{-1}$) in their seed protein (**Table 2**). It has been reported that plants grown under adverse condition can synthesize more anti-oxidants than their respective congenial growing environment (Woese*et al*., 1995). Organic growing environment itself creates some stress condition for the plants mainly because of their slow release and lower amount of plant nutrients in organic inputs than those of synthetic chemical inputs. Besides this, such type of observation may also be due to conducting the experiment in already organically converted experimental plot. The findings on different quality traits of the crop as observed in the present investigation are in close conformity with the earlier findings of Kanaujia*et al.* (1997) and Bahadur*et al.* (2006).

Table1:*Per se* performance of different studied yield attributes of garden pea as influenced by different treatments

Treatments	Days to 50% Flowering	Days to 1st pod harvest	Plant height (cm)	No. of pods.plant^{-1}	Pod length (cm)	No of seeds.plot^{-1}	Green pod yield (t.ha^{-1})
T_1	69.67^{ab}	87.00^{c}	60.00^{bc}	27.00^{cd}	9.31^{c}	8.13^{b}	12.15^{cd}
T_2	68.78^{abc}	88.00^{bc}	60.67^{bc}	27.67^{cd}	9.49^{bc}	8.05^{b}	12.56^{c}
T_3	69.00^{abc}	88.00^{bc}	63.33^{b}	29.33^{bcd}	9.51^{bc}	7.76^{b}	12.43^{c}
T_4	68.33^{c}	89.33^{b}	59.00^{bc}	32.33^{ab}	10.14^{abc}	8.00^{b}	12.74^{bc}
T_5	65.00^{d}	86.67^{c}	70.00^{a}	33.67^{a}	10.86^{a}	9.00^{a}	15.56^{a}
T_6	68.44^{bc}	90.00^{b}	63.67^{b}	30.00^{bc}	10.43^{ab}	8.04^{b}	14.63^{ab}
T_7	69.00^{abc}	89.33^{b}	59.67^{bc}	30.33^{abc}	9.50^{bc}	7.75^{b}	13.26^{bc}
T_8	70.00^{a}	92.67^{a}	57.00^{c}	26.00^{d}	8.00^{d}	6.87^{c}	10.17^{d}
SEm (±)	0.54	0.61	2.04	1.37	0.37	0.33	0.81
CD $_{(P \leq 0.05)}$	1.29	1.52	5.08	3.42	0.94	0.83	2.02

Table 2:*Per se* performance of different studied quality attributes of garden pea as influenced by different treatments

Treatments	Proximate composition per 100 g of edible portion (seeds)		
	Ascorbic acid ($mg.100g^{-1}$)	Total sugar (%)	Protein (%)
T_1	155.00^{c}	9.25^{bcd}	12.79^{cd}
T_2	150.00^{cd}	11.44^{ab}	13.37^{bcd}
T_3	130.00^{d}	12.67^{a}	11.54^{de}
T_4	140.00^{cd}	9.17^{bcd}	13.94^{bc}
T_5	220.00^{a}	13.33^{a}	16.25^{a}
T_6	183.00^{b}	10.67^{abcd}	14.74^{ab}
T_7	160.33^{bc}	8.04^{cd}	11.70^{de}
T_8	153.00^{c}	7.96^{cd}	10.25^{e}
SEm (±)	9.14	1.31	0.76
CD $_{(P \leq 0.05)}$	22.94	3.23	1.89

IV. Conclusion

The present day's conventional chemical farming practices and the over uses of agro-chemicals lead to degradation of soil health and reduce the quality yield of the crop. Such situation warrants the alternative approaches of farming for sustaining soil health and quality of crop produces.From the present investigation and findings therein, it may be concluded that *BD-501* and *Panchagavya* with their comparatively lower concentrations have significantly good effects over the yield and quality attributes of garden pea. In this context, T_5 [*BD-501 (2%)+Panchagavya* (3%)] emerged as the best treatment combination in terms of yield and quality expression of garden pea cv. Arkel.

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