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Impact of Integrated Nutrient Management (INM) on Growth and Yield of Field Pea (*Pisum sativum* L.) Crop under Doon Valley Conditions

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Abstract— *The experiment was conducted in randomized block design with 8 treatments viz. T_1 (RDF 100%), T_2 (RDF 75%+ VC), T_3 (Rhizobium+ PSB), T_4 (RDF 75%+ Rhizobium+ PSB), T_5 (RDF 75%+VC+ Rhizobium+ PSB), T_6 (VC+ Rhizobium+ PSB), T_7 (VC) and T_8 (Control/Check) at Agricultural Research Farm of Dolphin (P.G.) Institute of Biomedical & Natural Sciences, Manduwala (Dehradun). Treatments were replicated three times during the experiment. Growth parameters, seed and Stover yield (3155 kg ha^{-1}), Biological yield (5650 kg ha^{-1}) and harvest index were significantly superior in T_5 (RDF 75%+ VC+ Rhizobium+ PSB treatment) over other treatments.*

Keywords— ***RDF, VC, Rhizobium, PSB, INM and Field pea***

I. INTRODUCTION

Field pea, a major annual and herbaceous legume crop with both indeterminate and determinate type of Fabaceae family [1]. Although the origin and progenitor of pea are unknown, it is one among the world's earliest cultivated plants [2] identified four sites of origin as per genomic diversity: the near East, the Mediterranean, Abyssinia and Central Asia. According to [3], the Mediterranean gene centre is the primary locus of genetic diversity, with subsidiary loci in the near East and Ethiopia. It is traded as a dried and shelled product for use as human or livestock food and contrasts from fresh or succulent pea, which also is promoted as either fresh or preserved greens. Field pea (also known as dried peas or combined peas) are picked when they ripe. Dried peas are utilised whole or split, and are either ground into flour for human use or given to livestock to increase the nutritional value of feed [4]. As a result of its high protein content (21-25 percent), carbs, vitamin C and A, phosphorus and calcium, as well as its high level of lysine and tryptophan amino acid, it is widely utilised in human diet around the world [5]. The pea crop has a significant impact on soil fertility because these are N-fixing legumes and *Rhizobium leguminosarum* is required to improve nodulation. When pH of the soil falls below 5.7, inoculation becomes essential. Fertilizer requirements for crops following pea are reduced by 30-50 kg/ha [4]. Use of inorganic fertilizer alone is detrimental to soil health and production and should be avoided wherever possible. Utilizing organic and bio fertilizers increases crop productivity with maintaining the soil's overall health and vitality [6]. INM not just to show tremendous promise for crop productivity, but they also have the potential to manage the formation of numerous nutrient shortages and preserve excellent soil health conditions. This was taken into consideration attempts were undertaken to gather information on impact of INM on growth traits, yield and yield traits of field pea.

II. MATERIALS AND METHOD

Crop field pea cv. `Pant Pea-13 was tested in the field at Agricultural Research Farm of Dolphin (P.G.) Institute of Biomedical & Natural Sciences situated at Manduwala, Dehradun (UK) throughout *Rabi* season 2020-21. Experiment comprises of 8 treatments viz. T_1 (RDF 100%), T_2 (RDF 75% + VC), T_3 (*Rhizobium*+ PSB), T_4 (RDF 75%+

Rhizobium+ PSB), T_5 (RDF 75%+ VC+ *Rhizobium*+ PSB), T_6 (VC+ *Rhizobium*+ PSB), T_7 (VC) and T_8 (Control/check) in randomized block design replicated thrice. The mean highest and lowest temperature were 30-35°C and 6-10°C and relative humidity ranged from 19.33% to 100% throughout the experiment. The experimental crop field pea cv. 'Pant pea 13' @ 80 kg/ha seed rate sown by Kera method in lines spaced at 30×10 cm in plots of dimensions 5×3 meter and the crop plots were irrigated 2 times at 35 DAS & 70 DAS. No insecticides and fungicide were used during the entire crop cycle. PSB and *Rhizobium* were applied as seed treatment @ 50ml/10 kg seeds, VC @ 10t/ha and 20 kg/ha N, 40 kg/ha P and K were used respectively as per schedule. The key traits viz. plant height, root nodules plant^{-1}, dry matter accumulation plant^{-1}, root length, pod length, pods plant^{-1}, seeds pod^{-1}, seed yield (kg/ha), stover yield (kg/ha), biological yield (kg/ha) and harvest index were recorded and analysed statistically as per standard of ANOVA described by [7] as per schedule.

III. RESULTS AND DISCUSSION

The objective of the present investigation was bringing together comprehensive update to the research on INM on growth traits, yield & yield traits and the results obtained from this study have been discussed here are justified with possible scientific causes and support available literature present.

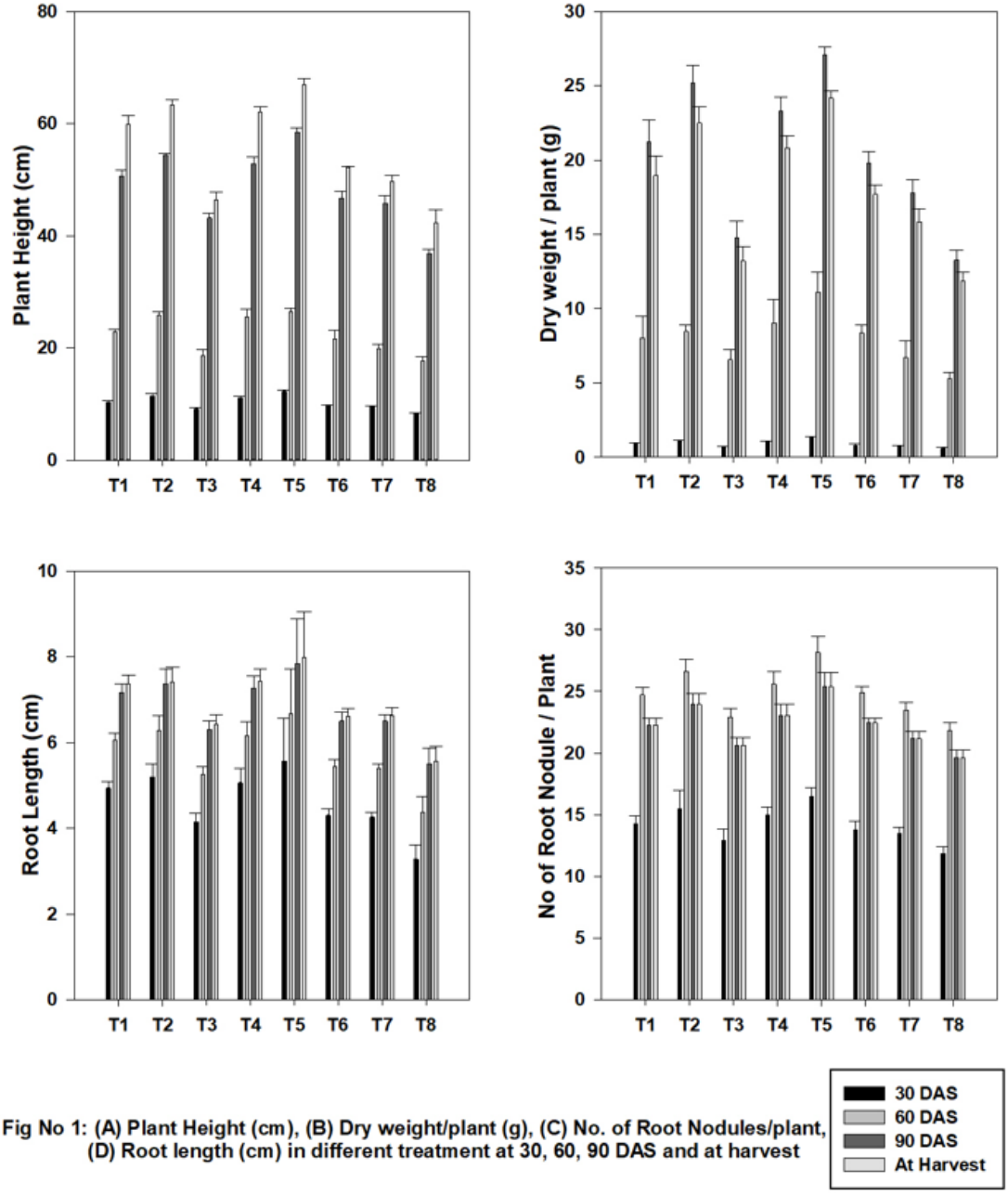

Fig No 1: (A) Plant Height (cm), (B) Dry weight/plant (g), (C) No. of Root Nodules/plant, (D) Root length (cm) in different treatment at 30, 60, 90 DAS and at harvest

Growth attributing characters

Observations on growth parameters viz. plant height (12.27, 26.4, 58.5 at 66.93 cm), dry weight plant^{-1} (1.3, 11.09, 27.07 and 24.17 gm), number of root nodules plant^{-1} (16.5, 28.15, 15.36 and 26.36), root length (5.56, 6.67, 7.83 and 7.97 cm) showed superior results in treatment T_5 (RDF 75%+ VC+ *Rhizobium*+ PSB) at 30, 60, 90 DAS and 120 DAS over other treatments i.e., remaining treatments showed medium significant growth and T_8 (Control) showed lowest results **(Figure 1)** during every stage of growth. On snow pea [8, 9], on garden pea [10] and on chick pea [11] reported similar findings in their studies. This might be attributed to the fact that *Rhizobium* and PSB secrete certain organic acid and some biochemical compounds which are growth stimulating in flora and all together nitrogen endorse plant height by increment of number and length of internodes [8].

Yield and Yield attributing characters

Yield and yield attributing parameters (**Table 1)** viz. number of pods plant^{-1}, pod length, number of seeds pod^{-1}, seed yield, stover yield, biological yield and harvest index of field pea demonstrated that combined application of bio inoculants (*Rhizobium*+ PSB), VC with 75% RDF had significant effect and gave superior results over all other treatments, lowest yield and yield attributing traits were in T_8 (control) where no fertilizer was applied. After analysing statistically, we found that treatment T_5 (RDF 75%+ VC+ Rhizobium+ PSB) had (2495 kg/ha) 59.94% more economic yield than T_8 (control) after applying combined nutrients. A possible explanation for this rise in yield attributing traits is that *Rhizobium* inoculation enhanced root growth and improved nutrient availability, resulting in intensive dry matter production plant growth and, which in turn resulted in improved flowering, pod formation and fruiting. An overall increase in yield attributes and yield of field pea, due to combined application of chemical fertilizers with bio fertilizers have also been reported by [5] on field pea [11] on chickpea, [10, 12 and 13] pea crop and [14] on black gram.

Table 1: Impact of INM on pods/plant, seeds/pod, pod length, yield and harvest index

Treatments	Pods/ plant	Seeds/ pod	Pod Length (cm)	Seed Yield (kg/ha)	Stover Yield (kg/ha)	Biological Yield (kg/ha)	Harvest index
T_1	14.98	4.76	6.77	2140	2935	5075	0.422
T_2	15.90	5.20	6.93	2380	3082	5462	0.436
T_3	12.95	3.66	6.23	1785	2708	4493	0.397
T_4	15.35	5.10	6.80	2305	3018	5323	0.433
T_5	**16.28**	**5.47**	**7.37**	**2495**	**3155**	**5650**	**0.442**
T_6	14.50	4.38	6.50	2090	2895	4985	0.419
T_7	13.95	4.07	6.23	1842	2815	4657	0.396
T_8	12.73	3.38	5.97	1560	2640	4200	0.371
C.D.	2.39	0.40	0.32	17.86	7.90	19.53	0.004
SE(m)	0.78	0.13	0.10	5.83	2.58	6.38	0.001

T_1 (RDF 100%), T_2 (RDF 75%+ VC), T_3 (*Rhizobium*+ PSB), T_4 (RDF 75%+ *Rhizobium*+ PSB), T_5 (RDF 75%+VC+ *Rhizobium*+ PSB), T_6 (VC+ *Rhizobium*+ PSB), T_7 (VC) and T_8 (Control/Check)

IV. CONCLUSION

It could be interpreted from one year data that growth traits (plant height, dry weight plant^{-1}, root nodules plant^{-1} and root length), yield and yield parameters (pod length, pods plant^{-1}, seeds pod^{-1}, seed yield, stover yield, biological and harvest index) were maximum in combined application of bio inoculants+ VC+ Chemical fertilizers as compared to their sole application and their use is very helpful for crop.

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