"Effect Of Integrated Nutrient Management In Field Pea (*Pisum Sativum* L.)"

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ABSTRACT
The experiment entitled **"Effect of integrated nutrient management in Field Pea (*Pisum sativum L.*) c.v. Arkel"** was conducted at research's field and laboratories of Uttaranchal University, Department of Agriculture, Dehradun (Uttarakhand). The experiment is carried out during the rabi season of December 2022 to March 2023. The present research investigates at the effects of INM on pea (*Pisum sativum*) growth, quality, and yield. The study's goal is to give useful information about the usage of INM optimization to improve pea crop performance. The study used a randomized block design (RBD) with three replications. Data on growth characteristics, quality traits, and yield components were gathered and examined statistically. The results demonstrated significant differences in plant growth, quality, and yield variables between treatments. The results indicate that the use of VC (Vermicompost), RH (Rhizobium), FYM (Farm Yard Manure) and NPK, influenced the growth, quality, and yield of the plants.
The experiment was carried out in Randomized block design (RBD) with 7 treatments and 3 replications included VC (Vermicompost), RH (Rhizobium), FYM (Farm Yard Manure) and NPK). The variety of pea used was Arkel. Experimental observation on crop growth parameters, yield attributes and quality parameters were recorded and analyzed statistically.

Key words: INM, FYM, NPK, Rhizobium, Vermicompost,

INTRODUCTION
The Leguminosae family, which the pea is a member of (Genus: *Pisum*, Subfamily: *Faboideae* Tribe: *Fabeae*), has a significant environmental benefit because it helps to develop low-input farming systems by fixing atmospheric nitrogen and by acting as a break crop, further reducing the need for outside inputs. More than 650.00 genera and 18,000.00 species make up the 3rdlargest family of flowering plants, which is the legume. In terms of financial significance, the Poaceae (grass family) is the most significant crop plant family, followed by the legumes, which account for around 27% of global crop production. The average pea includes about 22.6% of digesting protein, 50.0% of slowly digestible starch, 5.5% of soluble sugars, 62.1% of carbohydrates, 1.8% of fat, and various vitamins and minerals like calcium, iron, and riboflavin.

Considering its functions, it is categorized as:
a. Green manure crop or forage.
b. Edible dry seeds.
c. Green pods can be canned or frozen as fresh vegetables.
d. Edible podded peas.

Around the world, legumes make up roughly one-third of the direct protein consumed by people. They are also a significant source of culinary and industrial oils, as well as fodder and pasture for animals. Their ability to fix nitrogen symbiotically is one of the most crucial traits of legumes, highlighting their significance as a source of nitrogen in both natural and farmed environments. Additionally, natural substances (secondary metabolites) like is flavonoids that are thought to be advantageous to human health due to their anticancer and other health-promoting properties accumulate in legumes. Pea has also used as a model system in plant biology ever since Gregor Mendel's study.
Pea (*Pisum sativum*), is a leguminous plant in *Fabaceae* family that is widely grown around the world. On a global scale, it is the third most widely farmed crop. The weight of a pea ranges from 0.1 to 0.36 grams. As a winter crop, it needs a chilly growth season and constant temperate temperatures. Pulses hold a special place in agriculture and are high in protein, containing between 17 and 27 percent. In addition to being a great source of protein, they help sustain sustainable agriculture by biologically fixing nitrogen in the soil and preserving soil fertility. Moreover, the primary source of very nutritious fodder and grain concentrate for cattle is pulses.
One of the main production bottlenecks has arisen among the several agro-techniques needed to increase field pea production: timely crop management. Due to rising manpower costs and their scarcity for weeding, field pea farmers must

now employ integrated crop management practices, insect pest and disease management at peak demand. ICM, or integrated crop management, is a practical method for growing crops. ICM covers more aspects than Integrated Pest Management (IPM), which focuses on crop protection. IPM, soil, social, and environmental management are some examples of this. The emphasis on crop production has shifted in recent years from yields to quality and safety, with more recent attention being paid to sustainability issues. As a result, farmers and producers face new challenges every season.
Front line demonstrations on pulses done around the nation showed a yield benefit of 23.6% over farmer practice for all pulse crops (chickpea, pigeon pea, lentil, mungbeam, urdbean, and field pea). the IPM module, package technology, rhizobium injection, weed management, and varieties. Also, data showed that adopting enhanced varieties, fertilizer management, rhizobium inoculation, weed control, an IPM module, and package technology might increase field pea output by 26, 16, 8, 20, 24, 4, and 26.6%, respectively (Ali and Kumar, 2007).
Nutrient Management Integrated One of the elements of ICM focuses on maximizing the benefit from all conceivable sources of (INM) organic, inorganic, and biological components in an integrated manner in order to regulate the fertility of the soil and the provider of nutrients to plants at an ideal for maintaining the desired fertility. Inorganic fertilizers, which make up the majority of the mixture, are also supplemented by organic manure.
One of the main obstacles to increasing field pea yields is a heavy weed infestation since they compete with the other crop for moisture, light, nutrients, and space. Field pea is severely plagued by annual grasses, broad-leaved weeds, and sedges due to its slow early growth. Field peas are a crop that both encourages and suppresses weed growth. Weed growth is encouraged in field pea by wide row spacing and initial slow growth. At a later stage of development, however, this crop offers a good ground cover and fully smothers the weeds. Pre-emergence herbicide spraying becomes crucial during times of high labor demand to manage the initial weed population (Prasad, 2005).
Furthermore, crop performance is impacted by insects, pests, and illnesses. It offers a favorable environment for biotic agents to flourish on them due to its high nitrogen concentration. Field pea is known to struggle to cope against biotic stressors, and nodule damage brought on by insect pest and disease infestation may severely restrict nitrogen nutrition. A number of complementary techniques, including as cultural practices, physical devices, biological control agents, resistant crop varieties, plant-derived insecticides, and chemical management are used in (IPM), a pest control plan. Prevention, observation, and intervention are the three steps of application for these techniques. It is an ecological method of controlling insect populations below the point at which they become economically problematic. pests Bates *et al.*, (2005).
Using the previously mentioned observations, the following aims led the present study's research:
1) To analyse the effect of integrated nutrient management on growth and yield attributes of Pea.
2) To analyse the effect of integrated nutrient management on nutrient uptake
3) To analyse the effect of integrated nutrient management on quality parameters

METHODOLOGY

A field experiment was conducted to study the "Effect of integrated nutrient management in Field Pea (*Pisum sativum* L.)" was conducted at the experimental field, School of Agriculture, Uttaranchal University, Dehradun during 2022-2023 (December to March). The field study was completely designed using the RBD method, with seven different treatment combinations, each replicated in triplicate. The following summaries the observed data and necessary parameters. The variety of pea seeds was Arkel and sown on 11th December, 2022 and harvested on 12th March, 2023. Seeds were sown manually with recommended spacing of 30 x 15 cm with a depth of 4-5 cm and then covered with a thin layer of soil.

RESULTS AND DISCUSSION:

GROWTH PARAMETERS:

The data can be recorded and analyzed for growth attributing characters of pea (Table 1). Among the different treatment highest plant height (63.1 cm) was observed under treatment T_6 at harvest which was found to be at par withs T_1, T_3 and T_4. However, significantly shortest plant height (51.6 cm) was recorded under treatment T_7. The increased in plant height due to crowding might be explained from the fact that higher plant population density decreased penetration of light that might have increased endogenous auxin formation which enhanced the growth of the dormant bud. The results are also in line with the findings obtained by Gupta *et al*., (2017) Devi *et al.*, (2018) Lalito *et al.,* in (2018) Sangma *et al*., (2018)El-Salehein *et al.,* (2019)Mankar *et al*., (2020).

Table 1. Effect of nutrient management practices on lant height (cm) at various growth stages of field pea

TREATMENT	30 DAS	45 DAS	60 DAS	75 DAS
T_1 (100% RDF)	19.567	39.293	45.767	55.293
T_2 (75%RDF+25%RH)	18.610	38.343	45.270	55.920
T_3 (75% RDF+25% VC)	19.387	39.643	45.850	59.967
T_4 (50% RD+F25% RH+25% VC)	19.393	42.430	48.463	61.250
T_5 (75% RDF+25% FYM)	19.337	40.793	46.567	62.007
T_6 (25% RDF+25% RH+25% FYM+25% VC)	19.587	39.073	46.540	63.100
T_7 (CONTROL)	15.987	33.660	41.450	51.670
S.Em±	0.199	0.535	0.355	1.101
CDat 5%	0.621	1.666	1.106	3.429

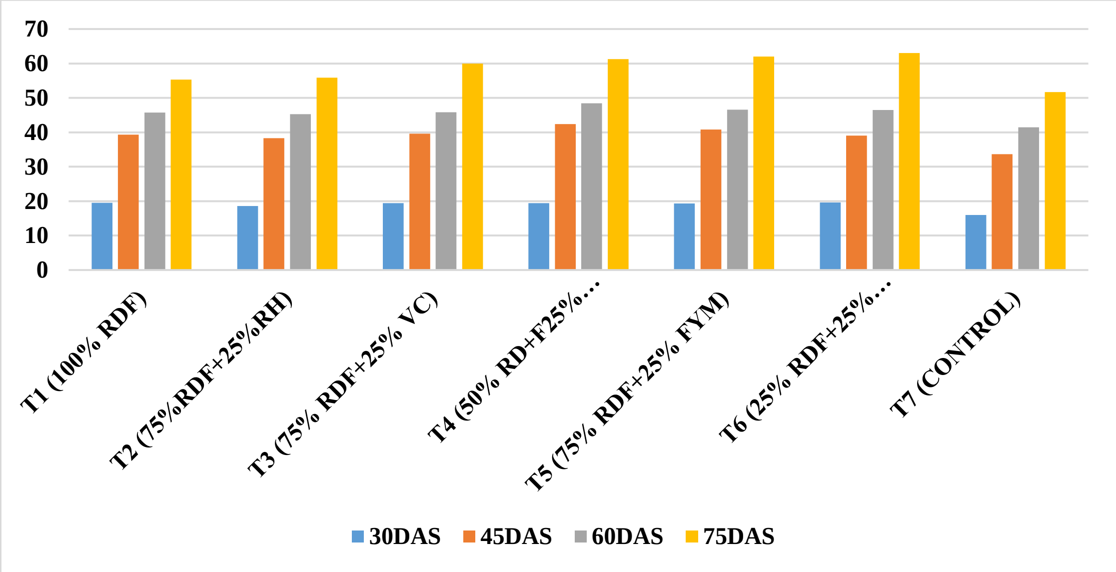

Fig 1. Effect of nutrient, weed and pest management practices on Plant height (cm) at various growth stages of field pea

Table 2. Number of branches per plant at various growth stages of field pea

Treatments	Number of branches per/plant			
	30 DAS	45 DAS	60 DAS	75 DAS
T_1 (100% RDF)	6.20	10.24	13.59	15.37
T_2 (75%RDF+25%RH)	6.16	10.08	13.07	15.05
T_3(75% RDF+25% VC)	6.37	10.36	13.58	15.39
T_4(50% RD+F25% RH+25% VC)	6.76	11.15	13.33	15.62
T_5(75% RDF+25% FYM)	6.23	11.06	13.28	15.45
T_6(25% RDF+25% RH+25% FYM+25% VC)	6.78	11.25	14.36	15.97
T_7(CONTROL)	5.57	9.27	11.65	13.97
S. Em±	0.14	0.15	0.22	0.17
C.D.at 5%	0.45	0.48	0.70	0.53

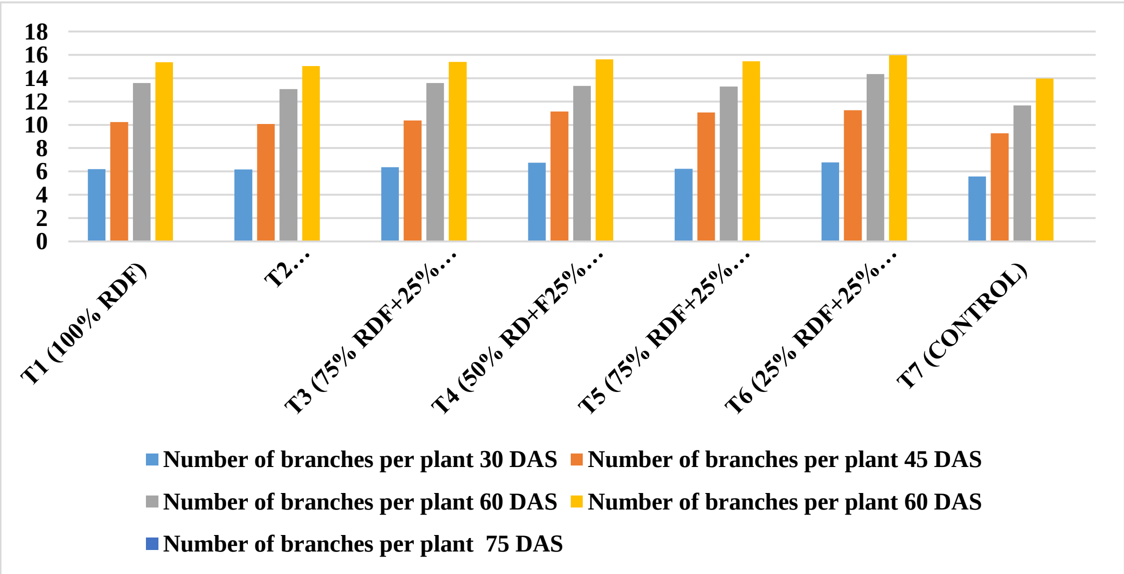

Fig 2. Number of branches per plant at various growth stages of field pea

YIELD AND YIELD ATTRIBUTES

The data can be recorded and analyzed for yield attributing characters in pea (Table 3). Significantly maximum pod length (7.93 cm) was observed under treatment T_3 which was at par with T_5 and T_6. However, minimum pod length (6.68 cm) was measured under treatment T_7 (CONTROL). The minimum number of pod per plant (18.63) was observed under treatment T_5(75% RDF+25% FYM). However, minimum number of pod per plant (14.95) was measured underT$_7$(CONTROL). Number of grains per pod maximum in under T$_3$(75% RDF+25% VC) and minimum in under T$_7$(CONTROL). The results are also in line with the findings obtained by Jaipaul *et al.*, (2011) Gopinath and Mina (2011) Chaudhary *et al.*, (2014) Singh *et al.*, (2016)Pawar *et al.*, (2017).

Table 3. Average number of pod per plant, number of seed per pod and pod length (cm) as influenced by different treatments of pea

Treatments	Number of pod per plant	Number of grains per pod	Pod length (cm)
T_1 (100% RDF)	16.863	6.700	7.650
T_2 (75%RDF+25%RH)	17.230	6.237	7.827
T_3 (75% RDF+25% VC)	18.523	6.750	7.937
T_4 (50% RDF+25% RH+25% VC)	17.253	6.327	7.703
T_5 (75% RDF+25% FYM)	18.633	6.100	7.263
T_6 (25% RDF+25% RH+25% FYM+25% VC)	17.153	5.957	7.193
T_7 (CONTROL)	14.953	5.537	6.683
S. Em±	0.914	0.334	0.318
C D at 5%	N/A	N/A	N/A

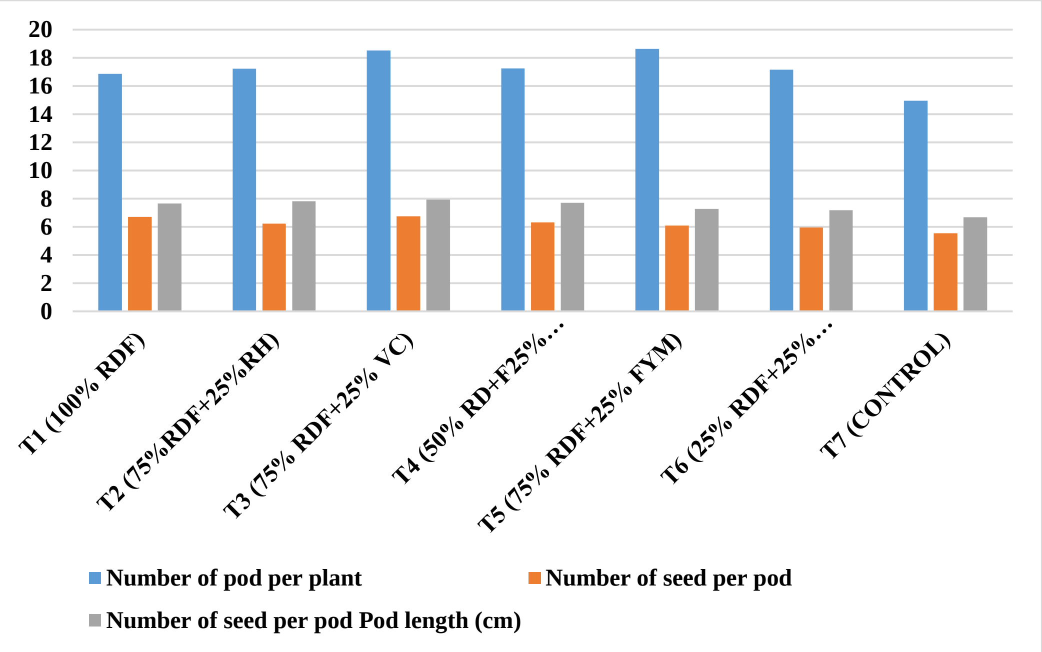

Fig 3. Average number of pod per plant, number of seed per pod and pod length (cm) as influenced by different treatments of pea

NUTRIENT UPTAKE AND QUALITY PARAMETERS

Maximum nitrogen uptake kg/ha by grains was (49.58) in T_4 (50% RD+F25% RH+25% VC) and minimum was (29.22) in T_7 (CONTROL) .In Phosphorus uptake (kg/ha)by grains maximum was (11.59) in T_1 (100% RDF) and minimum was (7.72) in T_7(CONTROL). In Potassium uptake (kg/ha) grain highest was (16.08) in T_1 (100% RDF) and lowest was (8.23) in T_7 (CONTROL). The results are also in line with the findings obtained by Kumari *et al.*, (2010) Singh *et al.*, (2011) Sepehya *et al.*, (2012) Mishra and Mahapatra (2016).

In quality parameters crude protein % maximum was recorded (18.64) in T_2(75%RDF+25%RH) and minimum (18.37) in T_7 (CONTROL). Ascorbic acid (mg/100g) highest was (10.43) in T_1 (100% RDF) and lowest was (8.27) in T_7(CONTROL). Total soluble solids (%) on quality parameter highest was (15.24) in T_1 (100% RDF) and lowest was (13.91) in T_7 (CONTROL). The results are also in line with the findings obtained by Vimala and Natarajan (2000) Nasreen and Farid (2003) Kumari *et al.*, (2010) Sepehya *et al.*, (2015).

Table 4. Nutrient up take by field pea crop as influenced by different treatments

Treatment	Nitrogen uptake (kg/ha)	Phosphorus uptake (kg/ha)	Potassium uptake (kg/ha)
	Grain	Grain	Grain
T_1 (100% RDF)	50.55	11.59	16.087
T_2(75%RDF+25%RH)	36.883	10.183	14.837
T_3 (75% RDF+25% VC)	43.22	9.413	12.667
T_4 (50% RD+F25% RH+25% VC)	49.587	11.327	15.15
T_5 (75% RDF+25% FYM)	43.07	10.563	13.993
T_6 (25% RDF+25% RH+25% FYM+25% VC)	48.27	10.827	14.407
T_7 (CONTROL)	29.227	7.723	8.23
S. Em.$\pm$	2.634	0.505	1.023
CDat5%	8.207	1.574	3.187

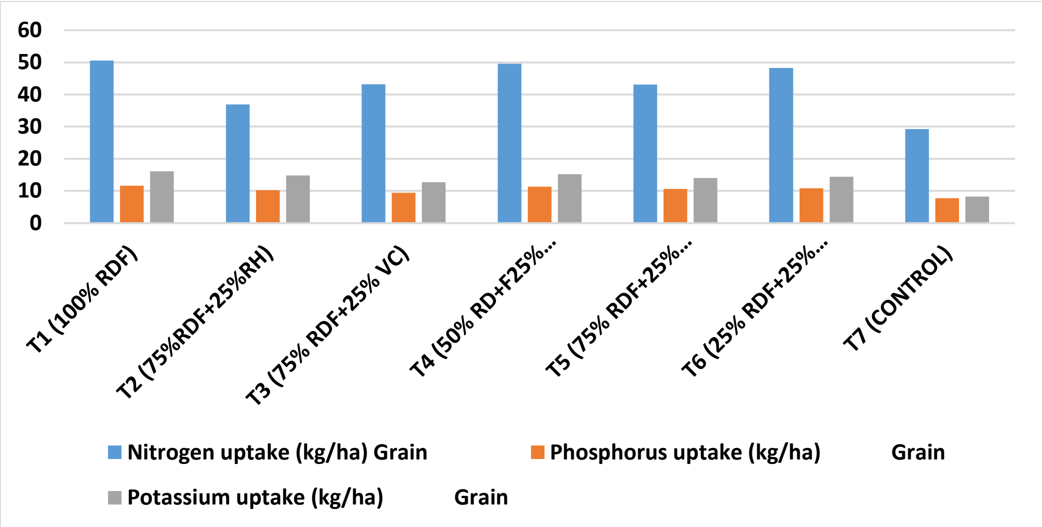

Fig 4. Nutrient up take by field pea crop as influenced by different treatments

Table 5. Effect of integrated nutrient management on quality parameters on field pea

Treatment	Crude protein (%)	Ascorbic acid (mg/100g)	Total soluble solids (%)
T_1 (100% RDF)	18.630	10.433	15.253
T_2 (75%RDF+25%RH)	18.640	9.303	14.680
T_3 (75% RDF+25% VC)	18.547	9.833	14.397
T_4 (50% RD+F25% RH+25% VC)	18.627	10.200	13.880
T_5 (75% RDF+25% FYM)	18.633	10.067	14.180
T_6 (25% RDF+25% RH+25% FYM+25% VC)	18.633	9.767	14.027
T_7 (CONTROL)	18.370	8.770	13.910
S. Em.$\pm$	0.074	0.233	0.228
CDat5%	N/A	0.725	0.709

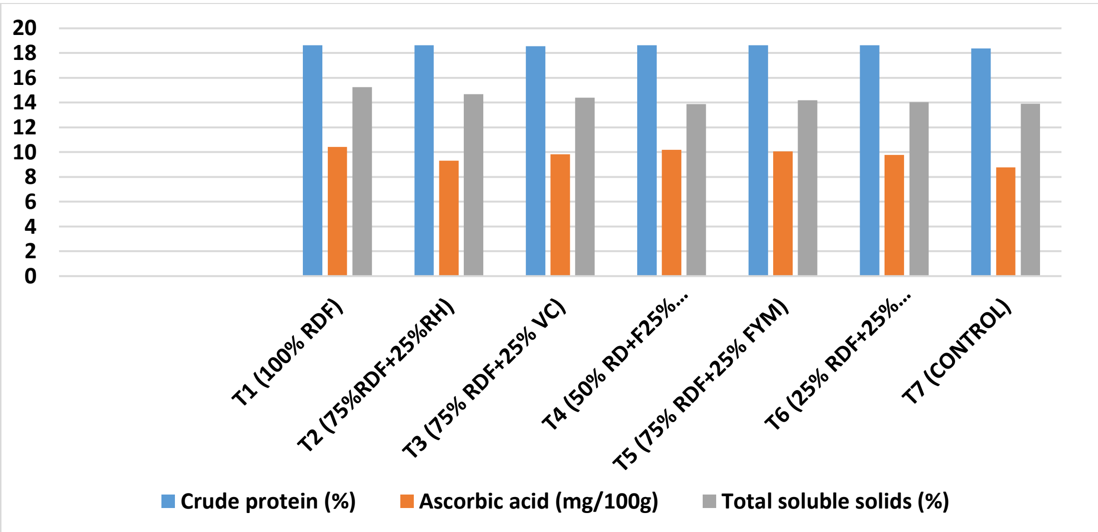

Fig 5. Effect of integrated nutrient management on quality parameters on field pea

CONCLUSION

T_2 (75%RDF+25%RH){75% Recommended dose of fertilizer + RH 25% soil application} which has the higher fertility levels among the different treatments was observed to be the best treatment combination comparing to others with respect to different parameters examined under this field investigation i.e., plant height in cm (30, 45, 60 and 75 days after sowing), production of primary and secondary branches (30, 45, 60 and 75 DAS), number of leaves (30, 45, 60 and 75days), no of nodules, fresh shoot weight, no of nodules, weight of nodules, fresh root weight, dry root weight, dry shoot weight, and yield parameters such as no of pods, pod length, pod yield, pod weight and number of grain per pods followed by T_4(50% RDF25% RH+25% VC). In terms of pea seed and biological yield, integrated usage of the integrated nutrients was shown to be more successful than their individual treatment. Integrated application of bio-fertilizer and VC with recommended dose of RDF has positive impacts on growth attributes and productivity. Application of integrate nutrients was found to be efficient in increasing biological yield and seed production compared to control in field pea.
Therefore, the said treatment combination of T_4(50% RDF+25% RH+25% VC) and interaction is recommended to the farmers and cultivators for maximum preference in both growth development and yield attributes if they prefer for opting chemical fertilizers.

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