Original Research Article

Appraisal the Effect of Nitrogen Phosphorus and Bio-fertilizers on Protein content in Seed of Garden Pea (*Pisum sativum* L.) cv. Arkel

Abstract

The field experiment was performed at Instructional Farm, College of Agriculture, Swami Keshwanand Rajasthan Agricultural University, Bikaner in the course of rabi year 2017-18.To study the effect of nitrogen, phosphorus and biofertilizers on the protein content of seeds of garden peas (Pisum sativum L.) cv. Arkel. The experiment was set up in RBD, with 11 treatments in three replications comparing nitrogen and phosphorus levels, as well as bio-fertilizers, to the control. .A significant increase in protein content from 15.60% to 22.06% when 20 kg ha-^{1} N + 40 kg ha-^{1} P + Rhizobium + PSB was applied (T_5).

Keywords: Phosphorus, protein content, bio-fertilizers, pea, nitrogen

Introduction

Garden pea [*Pisum sativum* (L.)] is a popular vegetable crop farmed all over the world. In India, It is mostly grown as a cool-season crop in North India's plains and as a summer vegetable in the hills. It has chromosomal number 2n=14 and belongs to the leguminoceae (Fabaceae) family.It is annual herbaceous plant as dwarf as 20 cm and as tall as 1 to 1.25 meter or more. It is self pollinated crop, fruit which is eaten, known as pod. . According to Choudhary, it is assumed to have originated in Ethiopia, a portion of Europe and Asia (1967)[4]. According to Thompson and Kelly, it is endemic to Europe and Western Asia (1957)[14]. Peas are mostly used as a vegetable and as a pulse. It can be eaten fresh, canned, processed, or dehydrated (Thamburaj and Singh, 2005)[13].

In India, the pea occupies 540 thousand hectares and produces 5427 thousand tonnes of grain (Anonymous, 2017)[3]. It is grown on around 13831 hectares in Rajasthan, with an annual grain production of 36375 tonnes (Anonymous, 2016)[2]. It is primarily grown in Rajasthan's Jaipur, Baran, Bundi, Kota, and Bharatpur districts.

Peas are nutrient-dense, with a high proportion of digestible protein, as well as carbs and vitamins. It also has a lot of minerals. It has 7.2 percent protein, 19.8% carbs, and 0.8 percent mineral content in its pod. Dried pea grains, on the other hand, are high in vitamins A, B1, B2, and C and include 19.7% protein, 56.6 percent carbohydrate, 2.1 percent mineral matter, and 4.4 percent iron. 1967 (Choudhary)[4]. Its importance as a green manure crop has long been known because it is a nitrogen-fixing legume. As chemical fertilisers become less available and more expensive, people are becoming increasingly interested in pea as a soil-building crop. Pea is a plant that responds well to nitrogen fertiliser, especially when it is young. Nitrogen helps to encourage the growth of leaves, stems, and other vegetative growth. It also boosts the amount of protein in peas.

The pea is a prolific nodulating legume that requires little nitrogen. Nitrogen, on the other hand, plays an important function in a variety of plant metabolic activities. It is a component of proteins and chlorophyll, as well as nucleotides, phosphatides, alkaloids, enzymes, hormones, vitamins, and other chemicals important in plant metabolism. It gives plants a dark green colour, speeds up early growth, and boosts the capacity to fix atmospheric nitrogen symbiotically. Nitrogen administration at lower doses to legumes in the early stages is critical for a vigorous start.

Low yields are caused by growing pulses without using phosphatic fertiliser Various researchers have reported that an appropriate supply of phosphorus is advantageous for legume growth and production, quality, and massive nodule development (Sammauria et al., 2009)[9]. It is an important structural component of cell membranes, chloroplasts, and mitochondria. It's found in energy phosphates like ADP and ATP, as well as nucleic acid, nucleoproteins, purines, pyrimidine, nucleotides, and a variety of co-enzymes.It is involved in the basic photosynthesis reaction. It is involved in cell division, carbohydrate breakdown for energy release, the transmission of hereditary traits, and the maturation of plants. Poor nodulation and low yield were noted in locations where legumes are typically farmed without phosphorus. On all soil types, phosphorus shortage is probably the most important single reason for poor leguminous crop productivity. The added phosphorus is said to have a twofold effect, raising both the production of the legume and the yield of the following crop.

The usage of bio-fertilizers is critical for enhancing fertiliser efficiency. When pulse seedlings are inoculated with Rhizobium and planted in these soils. It boosts their population in the rhizosphere, increasing the quantity of microbiologically fixed nitrogen available for plant growth. Seed inoculation with the correct Rhizobium culture strain boosts seed yield above the uninoculated control. The combination of Rhizobium with pulse plants improves soil fertility and is a low-cost nitrogen fertiliser strategy for legumes.

Due to a lack of population and low activity of Rhizobium strains, inoculation with effective Rhizobium and P-solubilizing strains in the presence of N and P fertilisers may help to increase production. In recent years, eco-friendly and low-cost bio-fertilizers, both N-fixer and P-solubilizer, have emerged as a significant and integral component of crop production's integrated plant nutrients supply (IPNS) system.

Around 93-99 percent of total phosphorus is insoluble in soil and so unavailable to plants directly. During the application season, only about a quarter of the water soluble phosphate is taken up by plants, with the rest being transformed to insoluble (unavailable) forms (Verma, 1993)[15]. Phosphate solubilizing first appearance Solubilizing microorganisms in the rhizosphere of crops and soil increase the availability of phosphate from insoluble sources, desorption of fixed phosphates, and phosphatic fertiliser efficiency (Gaur, 1991)[5]. Phosphate solubilizing bacteria secrete acidic compounds that solubilize inaccessible soil phosphorus and make it available to plants after being inoculated. As a result, the culture can be used as a broad-spectrum bio-fertilizer, potentially increasing crop yields by 10-30% and supplementing phosphorus needs by up to 30 kg P2O5 ha^{-1}. PSB culture improves crop nodulation, growth, nutrient uptake, and yield (Shrivastava and Ahlawat, 1993)[10].

Increased nitrogen content in seed, possibly as a result of increased nitrogen availability to plants. Increased activity of the nitrate reductase enzyme could be another reason for the elevated nitrogen concentration. Because nitrogen is a fundamental component of amino acids, which form the basis of protein, increased nitrogen in seed is directly responsible for higher protein.

Materials and Methods

The experimental study was conducted at the Instructional Farm, College of Agriculture, Swami Keshwanand Rajasthan Agricultural University, Bikaner, which is located 10 kilometres from Bikaner city on the Sri Ganganagar Road at an elevation of 234.7 metres above mean sea level, with a latitude of 280 01' N and a longitude of 730 22' E. According to the National Bureau of Soil Survey and Land Use Planning (NBSS & LUP), Bikaner is part of Agro ecological region No.2 (MgE1), which is characterised by deep, sandy and coarse loamy desert soils with low water holding capacity, a hot and arid climate, and annual precipitation of less than 300 mm. In this area, annual potential evapotranspiration (PET) ranges from 1500 to 2000 mm. Bikaner is located in the "Hyper Arid Partially Irrigated Western Agro-climatic Zone (IC)," according to NARP, Bikaner is part of the "Hyper Arid Partially Irrigated Western Plain Zone" Agro-climatic zone (IC). Bikaner is located in India's Agro-climatic Zone XIV (Western Dry Region), according to the National Planning Commission.

Weather and climate conditions

Weather and climate conditions Weather characteristics play a vital part in determining the growth and development processes of crops, as well as the manifestations of various applied treatments, so it's crucial to present the climatic data collected during the experiment. The environment of this zone is often arid, with acridity in the atmosphere and salinity in the rhizosphere, harsh temperatures in both summer and winter, and temperature shifts marked by sudden drops and rises. Furthermore, during the summer and winter months, the mean maximum and minimum temperatures fluctuate widely. The region's yearly average rainfall is around 200-300 mm, with the most of it falling during the south-west monsoon season of July to September. The Meterological Observatory at the Agricultural Research Station, Bikaner, recorded mean weekly data for temperature, relative humidity, rainfall, wet days, and mean evaporation.

Soil of experimental field

To determine the physical and chemical parameters of soil, soil samples ranging from 0 to 30 cm in depth were collected at random from various locations around the experimental field, and a representative composite sample was generated. The physico-chemical characteristics of the soil were determined using this composite sample.

Nitrogen content

An electrical grinder was used to grind the dry seed samples taken during harvesting and winnowing. To eliminate the black colour, the samples were digested with sulphuric acid and hydrogen peroxide. The nitrogen concentration was calculated using a colorimetric approach that used Nessler's reagent to create colour (Snell and Snell, 1949)[11] and was given as a percentage.

Protein content in seed

The protein content of dry seed was estimated by multiplying the nitrogen percentage in the seed by 6.25. (A.O.A.C., 1960)[1].

Result and Discussion

Nitrogen content

Table 2 shows that nitrogen content in plants varied greatly depending on nitrogen and phosphorus levels, as well as in conjunction with biofertilizers, as compared to the control. The method of treatment The maximal nitrogen concentration in plants was 20 kg ha^{-1} N + 40 kg ha^{-1} P + Rhizobium + PSB (T_5) (2.30 per cent). T_5 was statistically comparable to 20 kg ha^{-1} N + 40 kg ha^{-1} P + Rhizobium (T_3) and 20 kg ha^{-1} N + 40 kg ha^{-1} P + PSB (T^4), while the minimal nitrogen content in the plant (1.90%) was observed under control (T_0) Table 2 also shows the nitrogen concentration of seeds. Because of the various treatments, the nitrogen content in seed differed dramatically. The maximal nitrogen concentration in seed was 20 kg ha^{-1} N + 40 kg ha^{-1} P + Rhizobium + PSB (T_5) (3.53 per cent). T_5 remained on par with 20 kg ha^{-1} N + 40 kg ha^{-1} P (T_1), 20 kg ha^{-1} N + 40 kg ha^{-1} P + Rhizobium (T_3), 20 kg ha^{-1} N + 40 kg ha^{-1} P + PSB (T_4), 20 kg ha^{-1} N + 20 kg ha^{-1} P + PSB (T_6), 20 kg ha^{-1} N + 30 kg ha^{-1} P + PSB (T_7), 10 kg ha^{-1} N + 40 kg ha^{-1} P + Rhizobium ((T_9). Under control, the minimal nitrogen content in seed was found to be 2.50. (T_0).

Protein content in seed

Protein content in seed was found to vary dramatically under different nutritional levels and in combination with biofertilizers, as shown in table 3. The method of treatment The greatest protein content in seed was found at 20 kg ha^{-1} N + 40 kg ha^{-1} P + Rhizobium + PSB (T_5) (22.06 per cent). T_5 was statistically equivalent to 20 kg ha^{-1} N + 40 kg ha^{-1} P (T_1), 20 kg ha^{-1} N + 40 kg ha^{-1} P + Rhizobium (T_3), 20 kg ha^{-1} N + 40 kg ha^{-1} P + PSB (T_4), 20 kg ha^{-1} N + 20 kg ha^{-1} P + PSB (T_6), 20 kg ha^{-1} N + 30 kg ha^{-1} P + PSB (T_7), 10 kg ha^{-1} N + 40 kg ha^{-1} P + Rhizobium ((T_0).

Due to enhanced phosphorus solubility and better nitrogen fixation in nodules, the combination inoculation of seeds with Rhizobium + PSB was more advantageous in improving all of the above characteristics, resulting in increased nitrogen and phosphorus availability. These findings back up those of Vimla and Natarajan (2000)[16] and Tanwar et al (2003)[12].

Because of increased nitrogen content in seed, which could be the result of enhanced nitrogen availability to plants, a significant rise in protein content from 15.60% in control to 22.06% with application of 20 kg ha^{-1} N + 40 kg ha^{-1} P + Rhizobium + PSB (T_5) was observed in the current study. Increased activity of the nitrate reductase enzyme could be another reason for the elevated nitrogen concentration. Because nitrogen is a fundamental component of amino acids, which form the basis of protein, increased nitrogen in seed is directly responsible for higher protein. Kasturikrishna and Ahlawat (2000)[7], Pandya and Bhatt (2007)[8], and Gupta et al. (2009)[6]all came to similar conclusions .

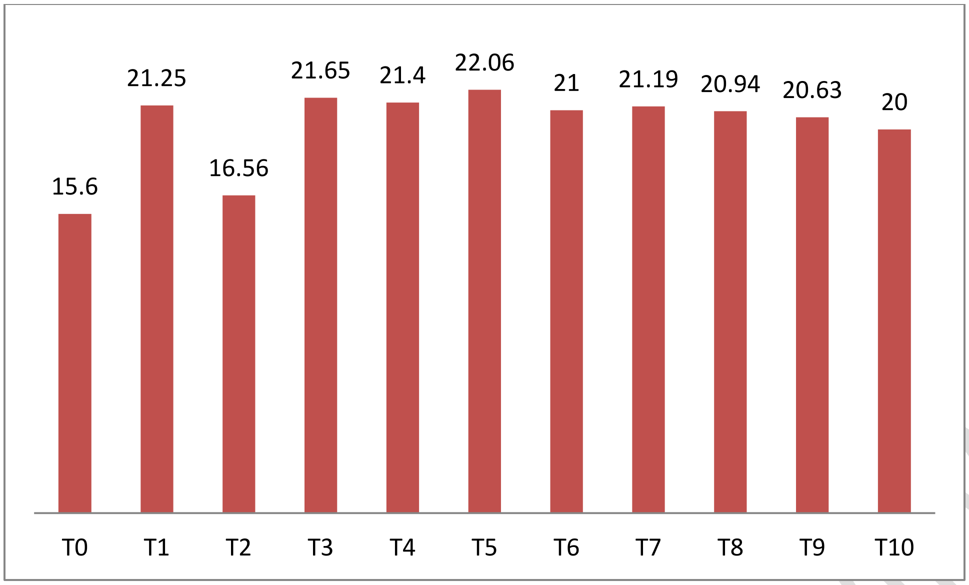

Fig-1 Protein content (%) in seed

Conclusion

Based on the results of a one-year experiment, it can be concluded that 20 kg ha^{-1} N + 40 kg ha^{-1} P + Rhizobium + PSB (T_5) recorded highest protein content in seed (22.06%), and that this treatment was significant compared to 20 kg ha^{-1} N + 40 kg ha^{-1} P + Rhizobium (T_3), 20 kg ha^{-1} N + 40 kg ha^{-1} P + PSB (T_4), 20 kg ha^{-1} N + 20 kg ha^{-1} P + PSB (T (T_0). These findings are simply indicative, and more research is required to gain a more consistent and conclusive conclusion.

Table 1. Details of the treatments with their symbols

S.N.	Treatments	Symbols

1.	Control	T_0
2.	20 kg ha^{-1} N + 40 kg ha^{-1} P	T_1
3.	*Rhizobium* + PSB	T_2
4.	20 kg ha^{-1} N + 40 kg ha^{-1} P + *Rhizobium*	T_3

	Treatments	**Nitrogen content (%) in plant**	**Nitrogen content (%) in seed**

5.	20 kg ha^{-1} N + 40 kg ha^{-1} P + PSB	T_4
6.	20 kg ha^{-1} N + 40 kg ha^{-1} P + *Rhizobium* + PSB	T_5
7.	20 kg ha^{-1} N + 20 kg ha^{-1} P + PSB	T_6
8.	20 kg ha^{-1} N + 30 kg ha^{-1} P + PSB	T_7
9.	10 kg ha^{-1} N + 40 kg ha^{-1} P + *Rhizobium*	T_8
10.	10 kg ha^{-1} N + 30 kg ha^{-1} P + *Rhizobium* + PSB	T_9
11.	10 kg ha^{-1} N + 20 kg ha^{-1} P + *Rhizobium* + PSB	T_{10}

Table 2. Effect of nitrogen, phosphorus and bio-fertilizers on nitrogen content in plant and seed of garden pea

T_0	Control	1.90	2.50
T_1	20 kg ha^{-1} N + 40 kg ha^{-1} P	2.15	3.40
T_2	*Rhizobium* + PSB	1.91	2.65
T_3	20 kg ha^{-1} N + 40 kg ha^{-1} P + *Rhizobium*	2.25	3.46
T_4	20 kg ha^{-1} N + 40 kg ha^{-1} P + PSB	2.20	3.42
T_5	20 kg ha^{-1} N + 40 kg ha^{-1} P + *Rhizobium* + PSB	2.30	3.53
T_6	20 kg ha^{-1} N + 20 kg ha^{-1} P + PSB	2.16	3.36
T_7	20 kg ha^{-1} N + 30 kg ha^{-1} P + PSB	2.18	3.39
T_8	10 kg ha^{-1} N + 40 kg ha^{-1} P + *Rhizobium*	2.10	3.35
T_9	10 kg ha^{-1} N + 30 kg ha^{-1} P + *Rhizobium* + PSB	2.00	3.30
T_{10}	10 kg ha^{-1} N + 20 kg ha^{-1} P + *Rhizobium* + PSB	2.08	3.20
SEm$\pm$		0.04	0.08
CD at 5%		0.11	0.24

Table 3. Effect of nitrogen, phosphorus and bio-fertilizers on protein content in seed of garden pea

	Treatments	**Protein content (%)**
T_0	Control	15.60
T_1	20 kg ha^{-1} N + 40 kg ha^{-1} P	21.25
T_2	*Rhizobium* + PSB	16.56
T_3	20 kg ha^{-1} N + 40 kg ha^{-1} P + *Rhizobium*	21.65
T_4	20 kg ha^{-1} N + 40 kg ha^{-1} P + PSB	21.40
T_5	20 kg ha^{-1} N + 40 kg ha^{-1} P + *Rhizobium* + PSB	22.06
T_6	20 kg ha^{-1} N + 20 kg ha^{-1} P + PSB	21.00
T_7	20 kg ha^{-1} N + 30 kg ha^{-1} P + PSB	21.19
T_8	10 kg ha^{-1} N + 40 kg ha^{-1} P + *Rhizobium*	20.94
T_9	10 kg ha^{-1} N + 30 kg ha^{-1} P + *Rhizobium* + PSB	20.63
T_{10}	10 kg ha^{-1} N + 20 kg ha^{-1} P + *Rhizobium* + PSB	20.00

SEm±	0.51
CD at 5%	1.51

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