EFFECT OF COWPEA AND BIOSTIMULANT HERAMIN ON GROWTH, GRAIN YIELD AND QUALITY OF MAIZE

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Abstract

A field experiment comprising of six treatments, *i.e.*, T_1: N_{100} +1 row cowpea, T_2: N_{100} + heramin, T_3: N_{100} + 1 row cowpea + heramin, T_4: N_{125}, T_5: N_{125} + 1 row of cowpea and T_6: N_{125} + 1 row of cowpea + heramin, was conducted at Research Farm of the Department of Agriculture, Maharishi Markandeshwar University, Mullana-Ambala, Haryana during *Rabi* season of 2022-23 to find out the effect of cowpea green manure and biostimulant heramin on growth, grain yield and quality of maize. The treatments, which were laid out in a Randomized Block Design (RBD), were replicated thrice. The variety of maize used for the experiment was $HQPM_4$. The maize plants (160.81 cm) were registered tallest with treatment T_6 where nitrogen was applied @ 125 kg/ha along with one row of cowpea and heramin spray. Dry matter accumulation (391g), grain yield (6650 kg/ha), Stover yield (6120 kg/ha), biological yield (12770 kg/ha), harvest index (52.08 %) and net return (₹ 120410) were recorded maximum under the same treatment, which was at par with T_3: N_{100} + 1 row cowpea + heramin spray in respect of plant height (160.54 cm), dry matter accumulation (390 g), grain yield (5400 kg/ha), Stover yield (5280 kg/ha), biological yield (10680 kg/ha), harvest index (50.56%) and net return (₹ 88200). Cowpea helped in the fixation of atmospheric nitrogen into the soil, which helped in increasing growth of maize and heramin reduced the need of fertilizer and increased growth of the maize plants.

Keywords: Heramin, cowpea, maize, biostimulant, Maize

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Introduction

Maize (*Zea mays*), belonging to the family Poaceae, is the third most important food crops after rice and wheat. In India, maize is known as *Queen of Cereals*. Maize in India contributes nearly 9% in the national food basket and serves as a basic raw material in thousands of industrial products, which include starch, oil, protein, alcoholic beverages, food sweeteners, pharmaceuticals, cosmetics, films and textile, gum, package and paper industries. Maize is cultivated throughout the year in all states of India for the purpose of grain, green cobs, sweet corn, baby corn and popcorn. The multiple uses of maize as a *fodder* and feed for animals make the maize more demandable. Due to this unique characteristics maize make a suitable option for enhancing farmers' income and livelihoods in India.

Nitrogen is considered a limiting nutrient for maize plants, and it is such a nutrient that the plants need the most. It is also one of the basic growths and yield promoting elements; therefore, nitrogen captured by the maize plants accumulates in stems and leaves. Application of nitrogen, especially during flowering, is directly related to the amount of seeds per cob. Increased nitrogen availability to the plants also has a positive effect on photosynthetic activity, plant growth, development, grain filling and productivity of maize plants (Brodowska *et al.*, 2022). Cowpea as green manure provides nitrogen to the maize plants through atmospheric nitrogen fixation and results in higher values for plant height, number of ears per plant, number of grains per cobs, grain weight and grain yield, however, cowpea does not give that much nitrogen to the plants than the nitrogen supplied trough urea in the soil in three split doses (Alla *et al*., 2015).

Biostimulant heramin reduces the need of fertilizers and increases plant growth, develops resistance in plants against abiotic stresses. In small concentration, this substance is efficient in favouring good performance of the plants' vital processes and allowing higher yield. In addition, biostimulants applied to plants enhance nutrients' efficiency, abiotic stress tolerance and plant quality traits (De Vasconcelos *et al*., 2019). Therefore, the experiment entitled effect of cowpea green manure and bio stimulant heramin on growth, grain yield and quality of maize was planned.

Material and Methods

A field experiment comprising of six treatments, *i.e.*, T_1: N_{100} +1 row cowpea, T_2: N_{100} + heramin, T_3: N_{100} + 1 row cowpea + heramin, T_4: N_{125}, T_5: N_{125} + 1 row of cowpea and T_6: N_{125} + 1 row of cowpea + heramin, was conducted at Research Farm of the Department of Agriculture, Maharishi Markandeshwar (Deemed to Be University), Mullana-Ambala, Haryana during *Rabi* season of 2022-23 to find out the effect of cowpea green manure and biostimulant heramin on growth, grain yield and quality of maize. The treatments, which were laid out in a Randomized Block Design (RBD), were replicated thrice and the plot size was 4.20 m^2. The variety of maize used for the experiment was $HQPM_4$. The experimental field located at 30˚17′0″N latitude, 77˚3′0″E longitude and at an altitude of 264 meters above the sea level. The soil of the field was sandy loam derived from Indo-Gangetic alluvium. Before sowing the seeds, the soil samples were drawn from a depth of 0 to 15 cm and from different positions of the field. The samples were analyzed in soil science laboratory for physical and chemical characteristics of the soil. The texture of the experimental field was sandy loam, pH 7.98 (slightly alkaline) through pH meter with glass electrodes method (Jackson, 1973), electric conductivity 0.89 dSm^{-1} through measures conductivity through method (Richard, 1954), moderate in organic matter (0.31%) through Walkey and Black (1934) method, rich in available nitrogen (173.05 kg ha^{-1}) method used alkaline permanganate (Subbiah and Asija, 1956) and potassium (469.73 kg ha^{-1}) through fame photometer technique (Piper, 1966) and medium in available phosphate (9.96 kg ha^{-1}) through Olsen approach method (Jackson, 1973).

Results and Discussion:

Plant height, Dry matter accumulation, Cob length, number of Cobs, number of grains per cob, test weight, grain yield, stover yield, Biological yield, Harvest index (%).

The plant height is taken at 30, 60, 90 and harvest stage. The best plant height is in T_6 (N_{125}+1 row of cowpea+ Heramin) (160.81 cm) which is at par with treatment T_3 (N_{100}+ 1 row cowpea + Heramin) with the height of (160.54cm).The best dry matter accumulation is in T_6 (N_{125}+1 row of cowpea+ Heramin) (391g) which is at par with treatment T_3 (N_{100}+ 1 row cowpea +Heramin) (390g). The best cob length after harvesting of crop is also in treatment T_6 (N_{125}+1 row of cowpea+ Heramin) (16.0 cm) which is statistically at par with T_3 (N_{100}+ 1 row cowpea + Heramin) (14.8 cm). The highest number of cob was in treatment T_6 (N_{125}+1 row of cowpea+ Heramin) (8 cobs) which is statistically at par with T_3 (N_{100}+ 1 row cowpea + Heramin) (7 cobs). The treatment

mean over varieties, revealed that T_6 (N_{125}+1row of cowpea+ Heramin) recorded significantly highest number of grains per cob (515) over all the treatments which is at par with T_3 (N_{100}+ 1 row cowpea + Heramin) (512). The highest test weight is recorded in treatment T_6 (N_{125}+1row of cowpea+ Heramin) (277g) which is at par with T_3 (N_{100}+ 1 row cowpea + Heramin) (268g). Grain yield was also high in T_6 (N_{125}+1row of cowpea+ Heramin) (6650) above respite all the treatment followed by treatment T_3 (N_{100}+ 1 row cowpea + Heramin) (5400). Maximum stover yield was in T_6 (N_{125}+1row of cowpea+ Heramin) (6120) which is at par with treatment T_3 (N_{100}+ 1 row cowpea + Heramin) (5280). Biological yield and harvest index is also high in treatment T_6 (N_{125}+1row of cowpea+ Heramin) (12770) and harvest Index (52.08%) which is at par with treatment T_3 (N_{100}+ 1 row cowpea + Heramin). Shown in table 1 and 2 .Plant bio stimulant increase crop productivity and reduce the need of fertilizer and cowpea helps in atmospheric nitrogen fixation athough PBS can stimulate maize tolerance to some abiotic stress, their effect in improving crop resistance to herbicide and effect of bio stimulants on plants has barely been investigated similar findings were found by (Panfili *et al*., 2019).

NPK Content and NPK uptake studies:

The maiximum NPK content in grains and stover was in treatment T_6 (N_{125}+1 row of cowpea+ Hairamin) which is at par with treatment T_3 (N100+ 1 row cowpea + Heramin) shown in table 3,4 .This might be a results of improved soil condition through intercropping and increased and sustained nitrogen availability over time. The improved availability of plant nutrients and solubilization of in soulable phosphates as a result of enhanced rhizosphere contribute to an increase in P absorption improved rhizosphere ecosystem using organic composts and heramin similar findings were found by (El-Fouly *et al*,. 2012).

Table 1: Table of Cob length, number of Cobs, number of grains per cob, test weight.

Treatments	Cob length (cm)	No. of cobs	No. of grains/cob	Test weight (g)	No. of seeds
T_1 (N100+ 1 row cowpea)	**13.1**	**4**	**480**	**230**	**13**
T_2 (N100+ Heramin)	**14.1**	**5**	**505**	**257**	**13**
T_3(N100+1rowcowpea+Heramin)	**14.8**	**7**	**512**	**268**	**13**
T_4 (N125)	**13.7**	**6**	**490**	**243**	**12**
T_5 (N125 + 1 row of cowpea)	**14.5**	**6**	**507**	**265**	**13**
T_6 (N125+1 row of cowpea+ Heramin)	**16.0**	**8**	**515**	**277**	**14**
SE(m)	**0.105**	**0.534**	**0.888**	**13.607**	**0.556**
C.D (5%)	**0.336**	**1.704**	**2.835**	**4.263**	**1.625**

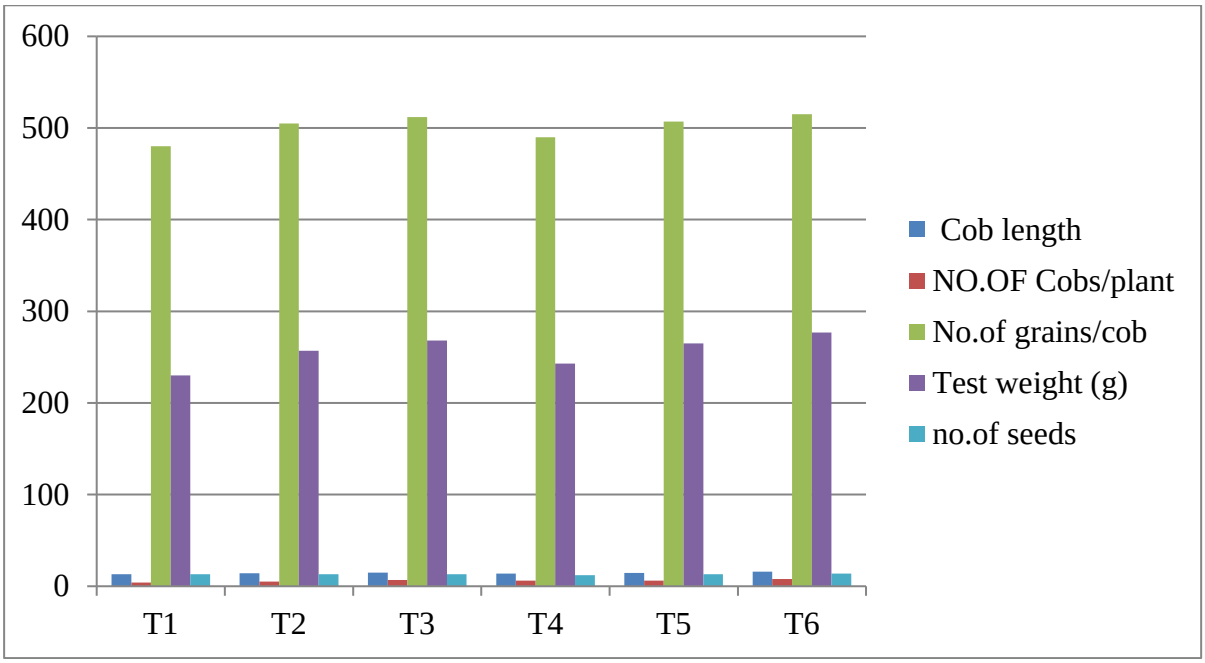


Table 2: Table of Grain yield, Stover yield, Biological yield and Harvest index

Treatments	Grain Yield (kg/ha)	Stover Yield (kg/ha)	Biological yield (kg/ha)	Harvest index (%)
T_1 (N100+ 1 row cowpea)	4100	3986	8086	50.70
T_2 (N100+ Heramin)	4310	4228	8538	50.48
T_3(N100+1rowcowpea+Heramin)	5400	5280	10680	50.56
T_4 (N125)	4280	4152	8432	50.71
T_5 (N125 + 1 row of cowpea)	4384	4262	8646	50.71
T_6 (N125+1 row of cowpea+ Heramin)	6650	6120	12770	52.08
SE(m)	52.152	35.762	49.259	0.008
C.D (5%)	166.459	114.144	157.224	0.0025

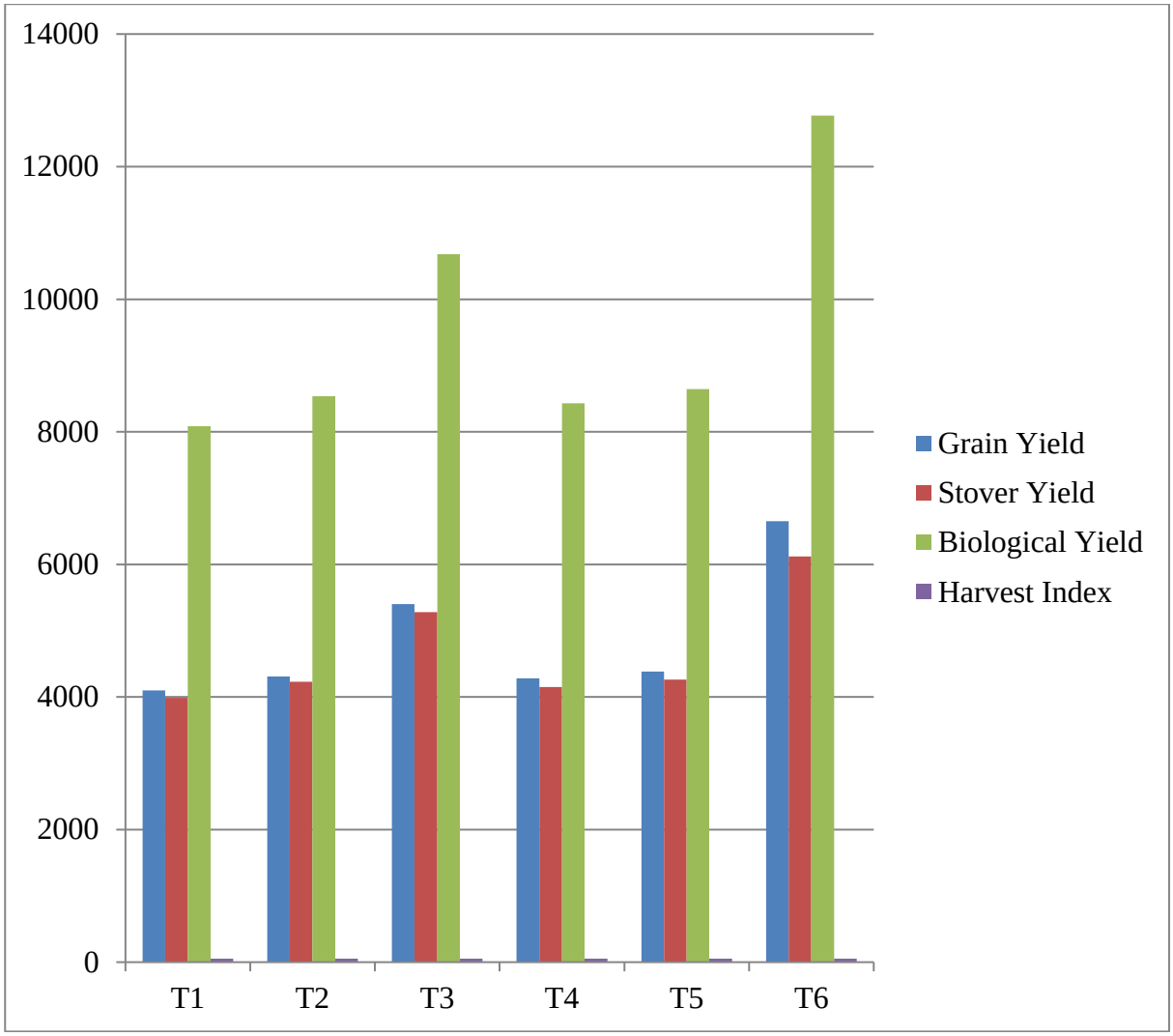


Table 3: Table of Available NPK Content in Grain

Treatments	Nitrogen (%)	Phosphorus (%)	Potassium (%)
T_1 (N100+ 1 row cowpea)	1.170	0.27	0.43
T_2 (N100+ Heramin)	1.263	0.37	0.52
T_3(N100+1rowcowpea+Heramin)	1.380	0.39	0.60
T_4 (N125)	1.260	0.36	0.48
T_5 (N125 + 1 row of cowpea)	1.263	0.38	0.56
T_6 (N125+1 row of cowpea+ Heramin)	1.480	0.44	0.63
SE(m)	0.028	0.006	0.005
C.D (5%)	0.009	0.019	0.018

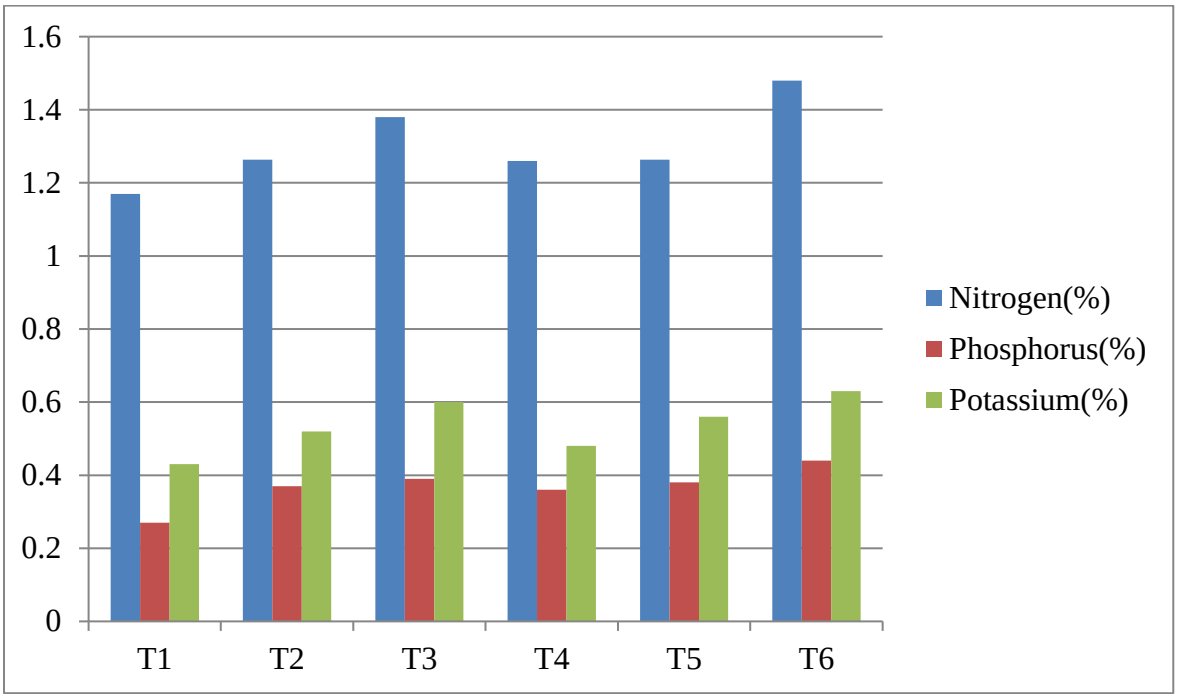
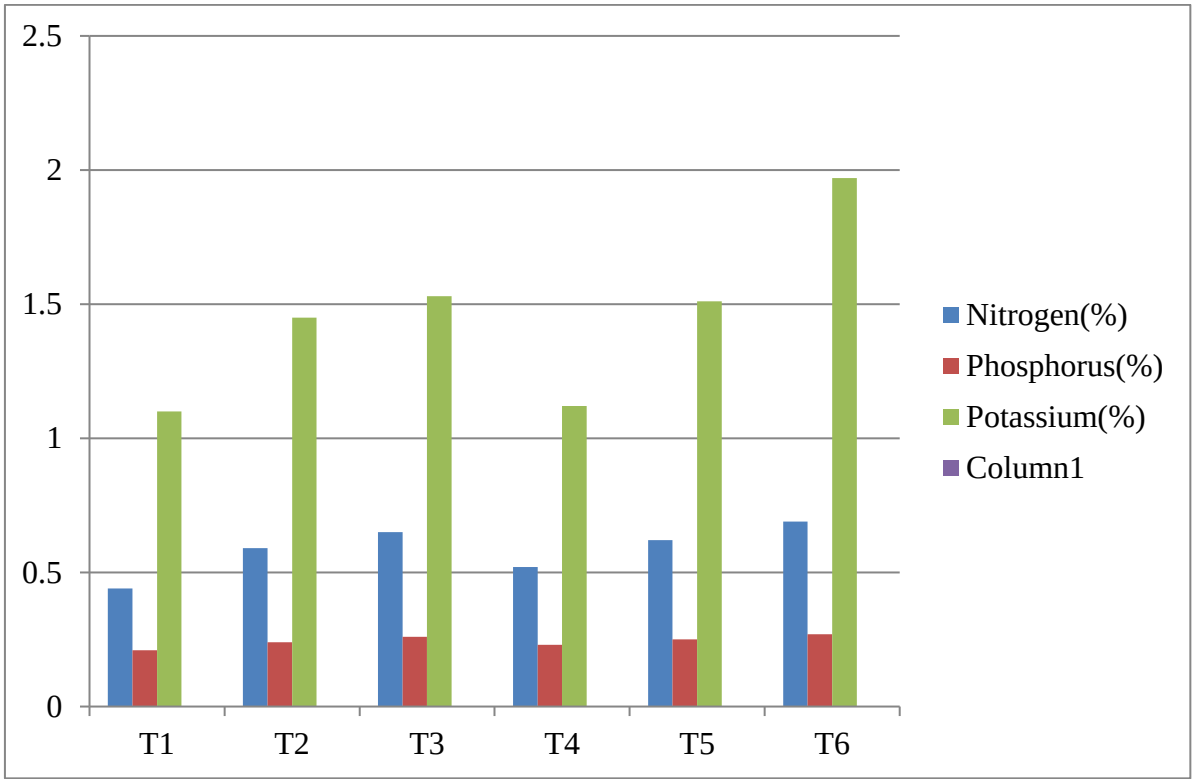


Table 4: NPK Content in stover

Treatments	Nitrogen (%)	Phosphorus (%)	Potassium (%)
T_1 (N100+ 1 row cowpea)	0.44	0.21	1.10
T_2 (N100+ Heramin)	0.59	0.24	1.45
T_3(N100+1rowcowpea+Heramin)	0.65	0.26	1.53
T_4 (N125)	0.52	0.23	1.12
T_5 (N125 + 1 row of cowpea)	0.62	0.25	1.15
T_6 (N125+1 row of cowpea+ Heramin)	0.69	0.27	1.97
SE(m)	0.006	0.006	0.005
C.D (5%)	0.020	0.019	0.015



Graphical Representation of NPK Content in Stover

Economics of crops:

Treatment T_6 (N_{125}+1 row of cowpea+ Heramin) is best in gross income and net income. Which is at par with treatment T_3 (N100+ 1 row cowpea + Heramin). Because it has highest Harvest index and growth of plants with these treatments is also good as compared to any other treatments. But cost of cultivation is also high in this treatments because we use cowpea as green manure and nitrogen is also given and heramin is also used in this treatments as compared to anyother treatments. Bhat *et al* (2020) reported that higher net return may be attributed to higher yield in the demonstration plots as compared by (Bhat *et al*.,2020).

Conclusion:

Treatment T_6 (N_{125}+1 row of cowpea+ Heramin) recorded with highest and best Plant height at (30, 60, 90 DAS) (25.70, 57.34, 145.76, 160.81) and maximum Grain yield (6650), Stover yield (6120), Biological yield (12770) and Harvest index (52.08) was in treatment T_6 that's way the economics of this treatment is also high as compared to anyother treatment and cost of cultivation is also high in this treatment Because we use Heramin, and showing of Cowpea for green manure and NPK is also given in treatment that's why cost of cultivation of this treatment is (₹ 55020) is high as compared to any other treatment. And Gross return (₹ 17540) and Net return (₹ 120410) is also high in this treatment. So the best treatment is T_6 (N_{125}+1 row of cowpea+ Heramin). Followed by treatment T_3 (N_{100}+ 1 row cowpea + Heramin) in this treatment there is one row of cowpea and recommended dose of nitrogen is given and Heramin is also sprayed on plants so this treatment is also similar to treatment T_6 (N_{125}+1 row of cowpea+ Heramin) but in treatment T_3 we reduce the dose of Nitrogen due to which plant height, dry matter accumulation, Harvest index, Grain yield, Cost of cultivation and Net return is also reduced as compared to treatment T_6. So the best treatment in this experiment is treatment T_6 (N_{125}+1 row of cowpea+ Heramin).

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