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Effect of Foliar Spray of Panchagavya and Micro-nutrient on Growth Attributes and Yield of Chickpea (*Cicer arietinum* L.) in Soils of Sand Loam

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present study highlights the effect of Foliar Spray of Panchagavya and Some Micro-nutrient on Growth Attributes and Yield of Chickpea (*Cicer arietinum* L.) in Soils of Sand Loam. A field experiment was conducted during *rabi,* 2023-24 at research farm, Vivekananda Global University, Jaipur. The experiment was layout in Randomized Block Design (RBD). The treatment consisted of three levels of Panchgavya (2, 4 and 6%), two level of micronutrients (B and Zn) (0.1 and 0.1%) and

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control. The soil in the experimental area was sandy loam with pH (8.21), Organic Carbon (0.21%), Available N (134.5 kg/ha), Available P (21.13 kg/ha) and Available K (202.24 kg/ha). Seeds are sown at a spacing of 30 × 10 cm to a seed rate of 80 kg/ha. The application of Panchgavya 6% + Zn 0.1 % + B 0.1 % significantly increased the Plant height (61.87 cm), No. of nodules/plant (12.87), Dry matter accumulation (123.01 g), Number of Pods/plant (62.13), Number of seeds/pod (2.10), Seed yield (1641.35 kg/ha) and Stover Yield (3542 kg/ha) of chickpea over the control.

Keywords: Growth attributes; yield of chickpea; legume crop; panchagavya.

1. INTRODUCTION

"Chickpea is one of the world's most important pulse crops. Scientifically it is named as *Cicer arietinum* L. and belongs to Leguminosae family. It is a highly nutritious pulse crop and among those food legumes that are cultivated throughout the world. Chickpea is believed to be originated in south-eastern Turkey and adjoining Syria. Chickpea is a cool season legume crop grown world-wide as a food crop. The seed is the main edible part of the plant. It is also called garbanzo gram or Bengal gram. Dried seeds of gram have a high nutritional value. Its dried seed contain about 7% moisture, 22.19% protein, 64.90% carbohydrate, 2.10% fat, 3.20% mineral ash, 45 mg/100 g Ca, 2.8 mg/100 g Fe and high calorific value (370 Kcal/100 g)" [1]. Chickpea is also a good source of minerals (calcium, phosphorus, magnesium, zinc and iron), unsaturated fatty acids, fibre and β-carotene). Chickpea also plays an important role in maintaining soil fertility by fixing nitrogen at rates of up to 140 kg/ha/year.

"Panchagavya, an organic product is the potential source to play the role for promoting growth and providing immunity in plant system. Panchagavya acts as growth promoter (75%), immunity booster (25%) and exactly fills the missing link to sustain the organic farming without any yield loss" [2].

Zn is involved in a number of the physiological and enzymatic processes that plants go through. A component of some proteins, tryptophan is synthesised by enzymes like dehydrogenase, proteinase, and peptidase, and it is also necessary for the synthesis of growth hormones (auxin) like indole acetic acid (IAA). It is also crucial for photosynthesis, nitrogen metabolism, cell division, and stability of cytoplasmic ribosomes.

In meristemetic tissues, boron is crucial for the production of new cells, appropriate pollination, fruit or seed formation, and nodule formation in legumes. Moreover, it is involved in the translocation of sugars, the creation of proteins and amino acids, the metabolism of carbohydrates, and the transport of N, P, starch, and sugar. It has been demonstrated that in some areas with acid soil conditions, B insufficiency significantly reduces chickpea output, even if it does so less so than Zn deficiency. When B content in soil is less than 0.3 mg kg^{-1} and crop response to B treatment is stronger in chickpea than in some cereals, B application becomes more significant.

2. MATERIALS AND METHODS

A field experiment was conducted at research farm, Vivekananda Global University, Jaipur

List 1. Treatment combination

S. No.	Treatments	Symbols
1.	Control (RDF 20: 50: 20 kg/ha NPK)	T_1
2.	Panchgavya 2% + Zn 0.1 %	T_2
3.	Panchgavya 2% + B 0.1 %	T_3
4.	Panchgavya 2% + Zn 0.1 % + B 0.1 %	T_4
5.	Panchgavya 4% + Zn 0.1 %	T_5
6.	Panchgavya 4% + B 0.1 %	T_6
7.	Panchgavya 4% + Zn 0.1 % + B 0.1 %	T_7
8.	Panchgavya 6% + Zn 0.1 %	T_8
9.	Panchgavya 6% + B 0.1 %	T_9
10.	Panchgavya 6% + Zn 0.1 % + B 0.1 %	T_{10}

during *rabi* seasons of the years 2023-24. The details of experimental techniques, materials used and criteria adopted for evaluation of treatments during the course of present investigation are described in this chapter. The experiment was laid out at Agronomy Farm, Vivekananda Global University, Jaipur during *rabi* seasons of 2023-24. Jaipur is situated at 260 5" North latitude and 750 28" East longitudes at an altitude of 427 meters above mean sea level. In Rajasthan, this region falls under Agro-climatic zone-IIIA (Semi-Arid Eastern Plains). The climate of this region is typically semi-arid, characterized by extremes of temperature during both summer and winter. The average annual rainfall of this tract varies from 300 mm to 400 mm and is mostly received during the months of July to September. All agronomic practices are followed in order in the crop period. Experimental data collected was subjected to statistical analysis by adopting Fisher's method of analysis of variance (ANOVA) as outlined by Gomez and Gomez (1984). Critical Difference (CD) values were calculated wherever the 'F' test was found significant at 5 percent level.

3. RESULTS

3.1 Growth Attributes

3.1.1 Plant height

At 60, 80 and 100 DAS, significantly and higher plant height (32.13, 51.83 and 61.87 cm, respectively) was recorded in treatment 10 [Panchgavya 6% + Zn 0.1 % + B 0.1 %] as compare to the rest of the treatment. However, the treatment-7 [Panchgavya 4% + Zn 0.1 % + B 0.1 %] (31.38, 50.56 and 58.44 cm, respectively) was found to be statistically at par with treatment-10 [Panchgavya 6% + Zn 0.1 % + B 0.1 %]. "As described by [3] that the increase in plant length might be due to the role of Zn foliar application in the synthesis of IAA, metabolism of auxins, biological activity, stimulation of an enzyme activity and photosynthetic pigments because of that, encourage vegetative growth of plants. B plays a crucial role in multiplication of cell in meristematic tissues in legumes" [4,5].

3.1.2 Dry matter accumulation

Panchgavya and micro-nutrient significantly enhanced the dry matter accumulation of chickpea over control. Application T_{10} (Panchgavya 6% + Zn 0.1% + B 0.1%) at 60, 80, and 100 DAS resulted in a maximum dry matter accumulation of 33.26, 82.81 and 123.01 g. However, the treatment-7 [Panchgavya 4% + Zn 0.1 % + B 0.1 %] (31.80, 80.64 and 119.14 g, respectively) was found to be statistically at par with treatment-10 [Panchgavya 6% + Zn 0.1 % + B 0.1 %]. Significant increases in plant dry weight may be attributed to Panchagavya foliar spray made improvements in dry matter accumulation, chlorophyll content, and nitrogen content discussed above may be attributed to higher yield and yield attributes with Panchagavya. Similar findings also reported by [6,7].

3.1.3 Number of nodules/plant

Panchgavya and micro-nutrient significantly enhanced the no. of nodules plant^{-1} of chickpea over control. At 60, 80 and 100 DAS, the application of T_{10} (Panchgavya 6% + Zn 0.1 % + B 0.1 %) revealed the highest number of nodule per plant, 44.67, 34.53 and 12.87. However, the treatment-7 [Panchgavya 4% + Zn 0.1 % + B 0.1 %] (43.63, 33.13 and 12.20, respectively) was found to be statistically at par with treatment-10 [Panchgavya 6% + Zn 0.1 % + B 0.1 %]. Significant and maximum number of root nodules per plant might be due to the better availability of nutrients from panchagavya which has many nutrients and effective conversion of nutrients from organics such as Fe, Mg and Zn available at the site of photosynthesis [8].

3.2 Yield Attributes and Yield

3.2.1 Number of pods per plant

The significantly maximum number of pods per plant 62.13 was recorded in treatment Panchgavya 6% + Zn 0.1 % + B 0.1 % which was superior over all other treatments. Significant increase number of pods/plant this might be due panchagavya which is an efficient plant growth stimulant that enhanced the biological efficiency of crops. Similar findings also reported by [9].

3.2.2 Number of seeds per pod

The significantly maximum number of seeds per pod 2.10 was recorded in treatment Panchgavya 6% + Zn 0.1 % + B 0.1 % which was superior over all other treatments. Significant increase in number of seeds per pod Probably may be due to favorable effect of panchagavya on reproductive growth *viz*., pods per plant which is one of the important yield attributes having significant positive correlation with seed & straw

Table 1. Effect of Panchgavya and micro-nutrient on plant height, Dry matter accumulation and No. of nodules plant^{-1} of chickpea

Treatment	Treatment combination	Plant height (cm)	Dry matter accumulation (g per m^2)	No. of nodules per plant
		100 DAS	100 DAS	100 DAS
T1	Control	52.65	106.61	7.13
T2	Panchgavya 2% + Zn 0.1 %	53.08	108.27	9.80
T3	Panchgavya 2% + B 0.1 %	55.50	112.49	10.67
T4	Panchgavya 2% + Zn 0.1 % + B 0.1 %	56.25	118.90	11.73
T5	Panchgavya 4% + Zn 0.1 %	54.14	109.93	10.40
T6	Panchgavya 4% + B 0.1 %	55.87	115.15	10.87
T7	Panchgavya 4% + Zn 0.1 % + B 0.1 %	58.44	119.14	12.20
T8	Panchgavya 6% + Zn 0.1 %	55.13	111.97	10.53
T9	Panchgavya 6% + B 0.1 %	56.09	115.67	11.20
T10	Panchgavya 6% + Zn 0.1 % + B 0.1 %	61.87	123.01	12.87
	SEm±	1.60	3.28	0.43
	CD (P=0.05)	4.76	9.73	1.29
	CV (%)	5.0	5.0	7.0

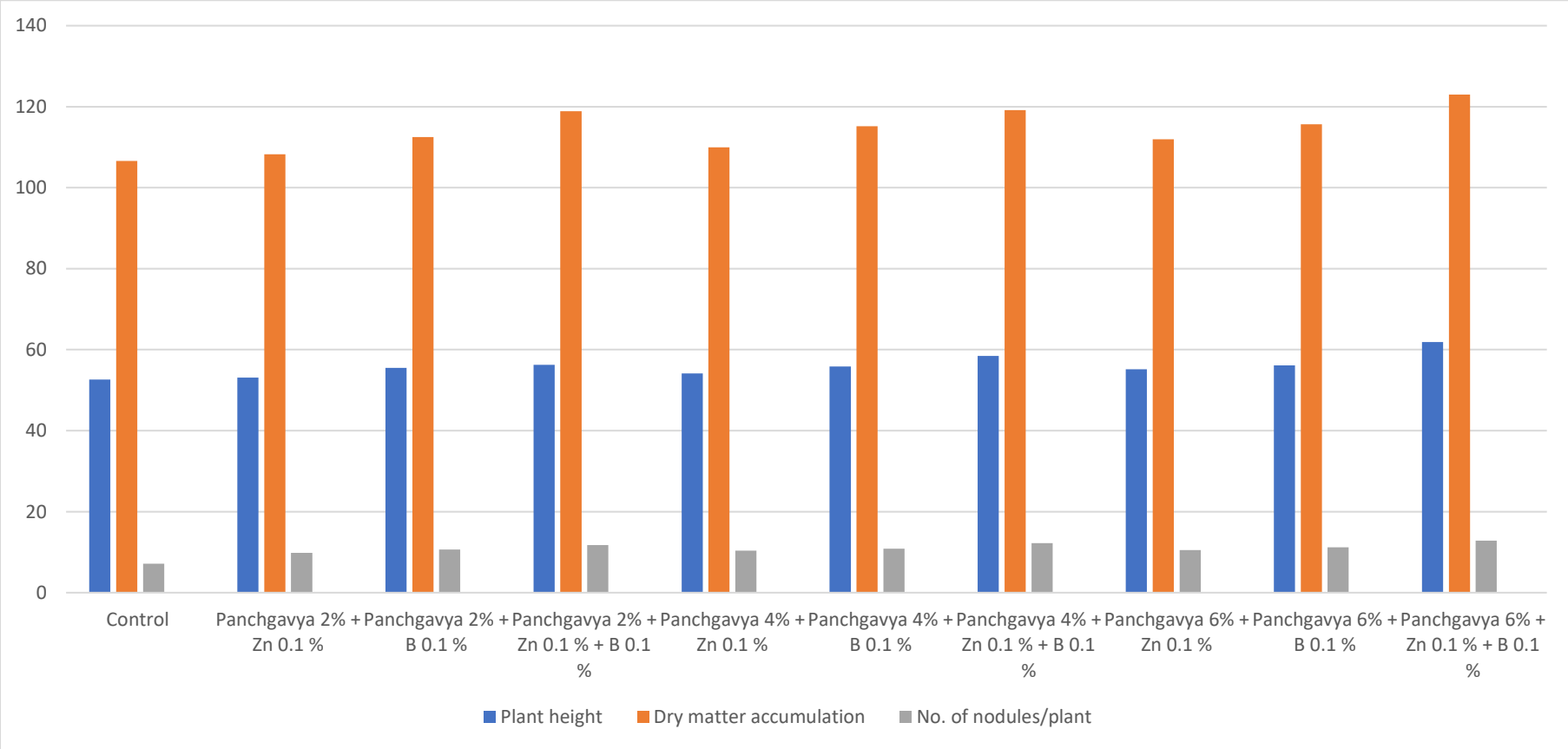

Fig. 1. Effect of Panchgavya and micro-nutrient on plant height, Dry matter accumulation and No. of nodules per plant of chickpea

Table 2. Effect of Panchgavya and micro-nutrient on No. of pods per plant, No. of seeds per pod and Test weight (g) of chickpea

Treatment	Treatment combination	No. of pods plant^{-1}	No. of seeds pod^{-1}	Test weight (g)
T1	Control	52.13	1.43	219.75
T2	Panchgavya 2% + Zn 0.1 %	54.33	1.50	221.53
T3	Panchgavya 2% + B 0.1 %	56.73	1.70	230.58
T4	Panchgavya 2% + Zn 0.1 % + B 0.1 %	58.93	1.97	238.70
T5	Panchgavya 4% + Zn 0.1 %	54.67	1.57	225.69
T6	Panchgavya 4% + B 0.1 %	57.53	1.83	235.62
T7	Panchgavya 4% + Zn 0.1 % + B 0.1 %	60.40	2.03	240.55
T8	Panchgavya 6% + Zn 0.1 %	55.73	1.63	229.55
T9	Panchgavya 6% + B 0.1 %	58.07	1.90	237.25
T10	Panchgavya 6% + Zn 0.1 % + B 0.1 %	62.13	2.10	241.04
	SEm±	1.64	0.10	5.95
	CD (P=0.05)	4.87	0.30	17.67
	CV (%)	5.0	10.0	5.0

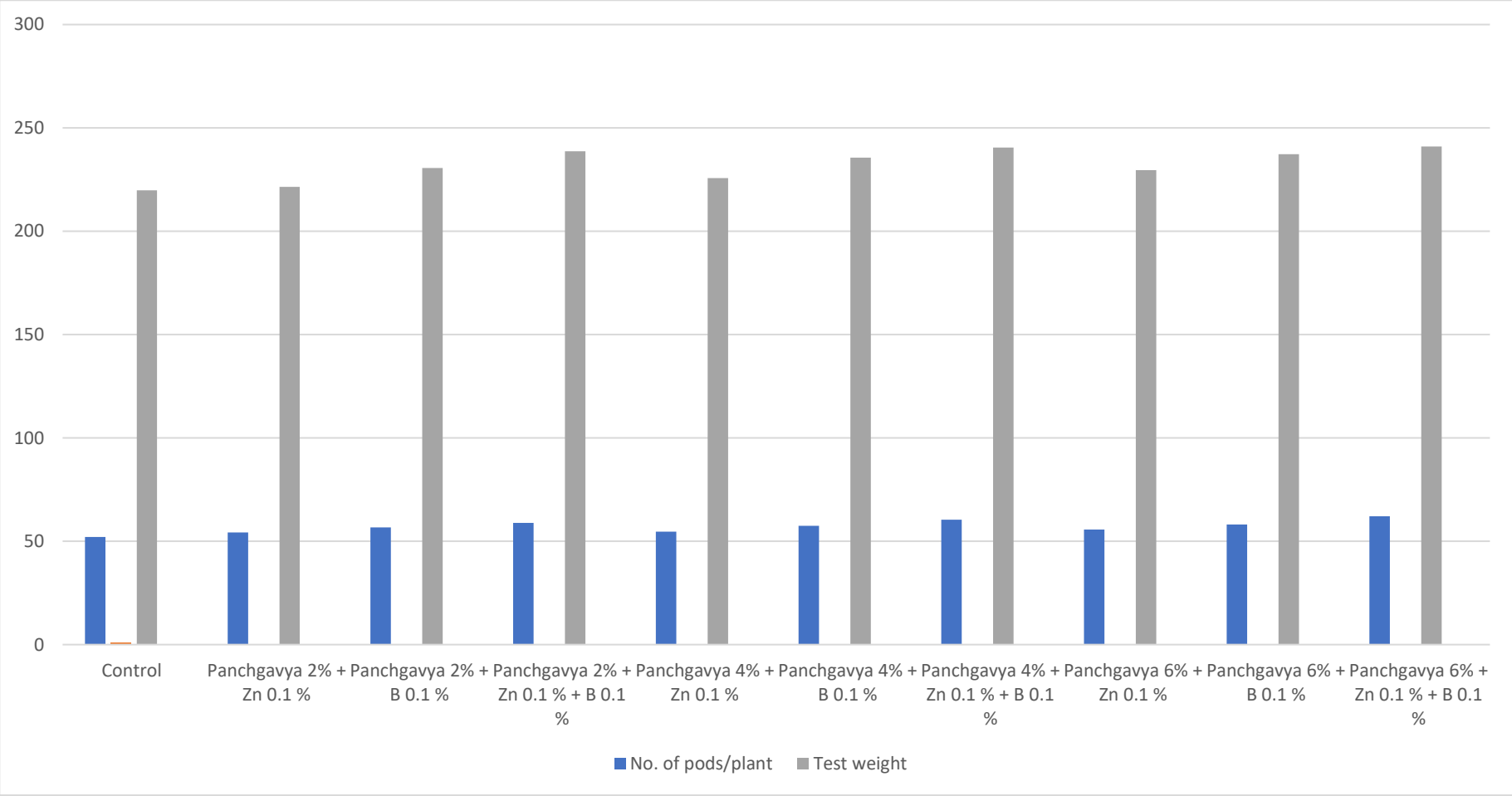

Fig. 2. Effect of Panchgavya and micro-nutrient on No. of pods per plant and Test weight (g) of chickpea

Table 3. Effect of Panchgavya and micro-nutrient on Seed yield (kg ha^{-1}), Straw yield (kg ha^{-1}) and HI (%) of chickpea

Treatment	Treatment combination	Seed yield (kg/ha)	Straw yield (kg/ha)	HI (%)
T1	Control	1204.29	3048.85	30.50
T2	Panchgavya 2% + Zn 0.1 %	1287.45	3075.00	30.76
T3	Panchgavya 2% + B 0.1 %	1414.36	3162.33	31.63
T4	Panchgavya 2% + Zn 0.1 % + B 0.1 %	1514.94	3270.00	32.71
T5	Panchgavya 4% + Zn 0.1 %	1336.74	3101.00	31.02
T6	Panchgavya 4% + B 0.1 %	1421.25	3169.67	31.71
T7	Panchgavya 4% + Zn 0.1 % + B 0.1 %	1555.76	3457.00	34.58
T8	Panchgavya 6% + Zn 0.1 %	1344.64	3141.30	31.42
T9	Panchgavya 6% + B 0.1 %	1444.67	3171.00	31.72
T10	Panchgavya 6% + Zn 0.1 % + B 0.1 %	1641.35	3542.00	35.43
	SEm±	43.62	95.67	0.96
	CD (P=0.05)	129.59	284.21	2.84
	CV (%)	5.3	5.2	5.2

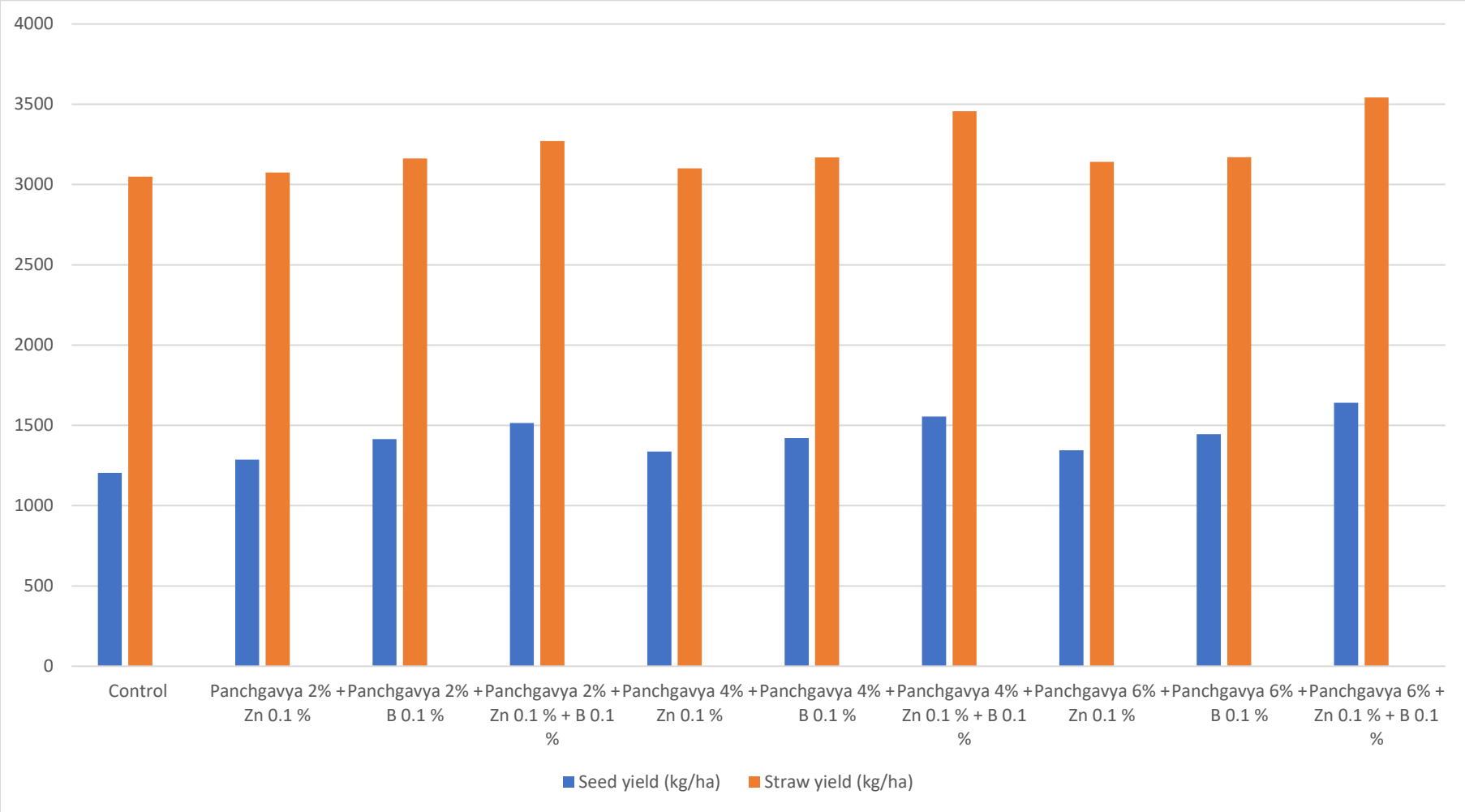

Fig. 3. Effect of Panchgavya and micro-nutrient on Seed yield (kg/ha), Straw yield (kg/ha) and HI (%) of chickpea

yield. Similar findings also reported by Choudhary et al. [10]. The crop produced more seeds in each pod thanks to the contributions of zinc and boron. Conversely, the control group documented the lowest amount of seeds per pod [11] was also noted comparable research.

3.2.3 Test weight (g)

Panchgavya and micro-nutrient significantly enhanced the Test weight (g) of chickpea over control. The maximum test weight (241.04 g) was recorded with the application of Panchgavya 6% + Zn 0.1 % + B 0.1 %. According to [12], applying zinc improves chickpea yields and quality. Through the use of micronutrient fertilization [13], crop responses in terms of production have been varied. It was also discovered that applying Zn and B significantly increased the Harvest index.

3.2.4 Seed yield, straw yield (kg/ha) and Harvest index (%)

The results indicated that increasing Panchgavya and micro-nutrient had a significant effect on seed and straw yield of chickpea. The application of Panchgavya 6% + Zn 0.1 % + B 0.1 % (T_{10}) recorded the significantly higher seed yield (1641.35 kg ha^{-1}) which was statistically remained at par with the application of Panchgavya 4% + Zn 0.1 % + B 0.1 % (T_7) (1555.76 kg ha^{-1}) and the lowest seed yield (1204.29 kg ha^{-1}) recorded in control (T_1). In case of Straw yield application of T_{10} (Panchgavya 6% + Zn 0.1 % + B 0.1 %) also recorded the significantly higher Straw yield (3542 kg ha^{-1}) which was statistically remained at par with the application of T_7 Panchgavya 4% + Zn 0.1 % + B 0.1 % (3457 kg ha^{-1}) and the lowest Straw yield (3425 kg ha^{-1}) recorded in control (T_1). Highest harvest index was recorded in treatment Panchgavya 6% + Zn 0.1 % + B 0.1 %. The maximum stover yield might be due to the IAA and GA present in panchagavya when applied as foliar spray could have created stimuli in the plant system and increased the production of growth regulators in cell system and the action of growth regulators in plant system ultimately stimulated the necessary growth and development This may be due to the positive impact on plant height and reproductive growth characteristics, which are both indicators of vegetative development. The similar findings were also reported by [14,15]. Application of Zn enhance quality and yields of chickpea reported by Khan et al. [16].

4. CONCLUSION

Application of Panchgavya and Micronutrient (Zn and B) by foliar spray is beneficial for better yield and quality production of chickpea crop. In order to maintain a number of physiological, biochemical, yield, and quality parameters, it is therefore suggested that the application of Panchgavya (6%), Zn (0.1%), and B (0.1%) commands a great significance. These include maintaining growth and relative water content, increasing nitrogen and protein content, and increasing the grain's zinc and boron content, which addresses mineral deficiency issues.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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