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Effect of seed priming, phosphorus and foliar spray of leaf extract on growth and yield of chickpea

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Abstract
A field experiment was conducted during Rabi 2022 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The experiment was laid out in Randomized Block Design with ten treatments which are replicated thrice on the basis of one year experimentation. The treatments consisted of 3 levels of phosphorus (40, 60, 80 kg/ha), and Tulsi leaf extract 5%, Moringa leaf extract 15%, Neem leaf extract 10% as a foliar spray and a control. The application of Phosphorous 60 kg/ha + Neem leaf extract 10% recorded significantly higher Plant height (56.1 cm), Plant dry weight (42.21 g/plant), number of nodules per plant (31.0), number of branches per plant (19.0). Significantly maximum Seed yield (2182.02 kg/ha), stover yield (3148.08 kg/ha) were obtained in the treatment of Phosphorous 60 kg/ha + Neem leaf extract 10%. It was concluded that for obtaining higher yield components with better quality of Chickpea application of Phosphorous 60 kg/ha + Neem leaf extract 10% was recorded significantly maximum Seed yield (2182.02 kg/ha) as compared to other treatments. Since, the finding based on the research done in one season.

Keywords: Chickpea, phosphorus, Moringa leaf extract, neem leaf extract, tulsi leaf extract

Introduction
Chickpea, (*Cicer arietinum* L). belongs to the family Fabaceae, within the tribe Cicerae. It is a self-pollinated, diploid, annual grain legume crop. The global production of chickpea is nearly 11 million tonnes and India is the major producer accounting for 64% of the total chickpea production (FAOSTAT, 2012) [3]. It is a major source of high quality protein in human diet and also provides high quality crop residues for animal feed.

India rank first in area (73%) and production (75%) at Global level followed by Australia, Turkey and Ethiopia. In major producing countries the highest productivity of 2170 kg/ha is observed in Ethiopia followed by Australia (1725 kg/ha), Russian Fed. (1358 kg/ha) and Myanmar (1315 kg/ha). India's productivity is 1261 kg/ha. This crop was cultivated in about 101 L ha. The country harvested a record production of 116 Lt at a highest productivity level of 1145 kg/ha. As usual, Madhya Pradesh has contributed a significant 25% of the total gram area and 30% of total gram production in the country, thereby ranking first both in area and production followed by Rajasthan (20% & 19%), Maharashtra (21% and 19%), and Gujarat (6% & 8%).

About 98 percent of gram production of the country during the period under report has been realized by 10 states of Madhya Pradesh, Rajasthan, Maharashtra, Gujarat, Karnataka, Andhra Pradesh, Jharkhand, Chhattisgarh and Telangana (2021-2022). In Uttar Pradesh area under production was 5.83 lakhs ha, and production is about 7.47 lakhs tonnes with average yield per ha was 1282 kg/ha.

Phosphorus uptake and transport is mediated by the presence of high-and low affinity transport systems that vary in their Michaelis-Menten constant (Km) values and operate at low and high P concentrations, respectively (Smith *et al*. 2000; Guo *et al*. 2002) [16, 6]. Some specific growth factors that have been associated with P are: stimulated root development, increased stalk and stem strength, improved flower formation and seed production, more uniform and earlier crop maturity, increased nitrogen N-fixing capacity of legumes, improvements in crop quality, and increased resistance to plant diseases (Griffith, 2010) [8].

Phosphorus transformations and mobility in the soil-plant system are controlled by a combination of biological, chemical and physical processes. In natural ecosystems plant growth is often limited by P availability, while P is generally recycled and retained efficiently (Frossard *et. al*., 2000) [4]. However, in managed ecosystems continued inputs of P in the form of fertilizers and imported fodder profoundly affect the quantity, availability and dynamics of soil P (Pierzynski *et. al*., 2000) [15]. A pronounced effect of P application on chickpea yields has been reported by Fairhurst and Witt (2002) [5]. The number of pods and seed index was improved under higher P applications (Kumar and Sreenivasulu, 2004) [13]. Gruhn *et al*. (2000) [7] reported higher grain yield in gram due to organic P application.
Botanical seed treatment is derived from natural sources based on botanical ingredient. It is liquid, natural seed treatment and root growth promoter formulation. It also stimulates indigenous microbes in the root zone. It is proven to be a reliable performer in low and high rainfall areas and in all soil types. It is an affordable and effective way to optimize early growth and yield potential. It is also one of the lowest financial investments through which a grower can make to maximize productivity and improve the bottom line. Seed priming is a common practice followed to improve seed performance with respect to uniformity of germination and rate of germination (De Lespinay *et al*., 2010) [2]. Seed priming is the process of regulating germination by managing the temperature and seed moisture content, in order to maximize the seed's potential. Applying moringa leaf extract is a cheap and environment friendly organic technology which increases growth of most vegetable crops like rape, cabbage and tomato, and field crops including maize and common beans. Hence, moringa leaf extract can be used as an organic fertilizer for the farmers. The effect of moringa leaf extract is analogous to synthetic hormonal effect because the extract contains zeatin, a purine adenine derivative of plant hormone group cytokinin (Makkar *et al*., 2007) [14] and this zeatin enhances the antioxidant properties of many enzymes and protects the cells from aging effects of reactive oxygen species.

Natural Pesticide
Insect Repellent: Neem leaf extract acts as a natural insecticide, repelling pests like aphids, whiteflies, and caterpillars without harming beneficial insects.

Insect Growth Regulator: It interferes with the life cycle of insects, preventing them from maturing and reproducing.

Fungicide
Disease Prevention: Neem leaf extract has antifungal properties that help protect plants from fungal diseases such as powdery mildew, rust, and black spot.

Materials and Methods
The experiments on the effect of phosphorus and foliar application of leaf extract along with recommended dose of fertilizers (RDF) on the growth and yield enhancement of chickpea were conducted at *Rabi* season of 2023 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj which is located at 250 24 42 N latitude, 810 50 56 E longitude and 98 m altitude above the mean sea level. This area is situatedon the right side of the river Yamuna by the side of Prayagraj Rewa Road about 5 km away from Prayagraj city. A composite soil sample was collected at a depth of 0-30 cm. It was air dried, crushed, and tested for physical and chemical properties. The soil was sandy clay loam in texture with soil reaction of (pH 7.1), 0.58 organic matter (0.65%), available nitrogen (146.2 kg/ha), phosphorus (8.31 kg/ha), potassium (154.42 kg/ha), sulphur (6.8 mg/kg), Zn (0.47 mg/kg) and available B (0.39 mg/kg). Chickpea variety Pusa 362 was selected for sowing. Seeds were sown in line manually on 2023. Seeds were covered with the soil immediately after sowing. The spacing adopted was plant to plant 10 cm and row to row 30 cm according to the treatment details and the seeds were drilled at 3-4 cm depth.

Preparation of neem leaf extract
Materials Needed
- Fresh neem leaves (or dried neem leaves)
- Clean water
- Blender or mortar and pestle
- Fine mesh strainer or cheesecloth
- Container for storage (preferably a dark glass bottle)

Steps
Harvest Fresh Leaves
Collect fresh neem leaves from a tree. Ensure they are free from peste and damaged.

Drying (if using dried leaves)
Spread the leaves out in a thin im a shaded well ventilated area until they are dried and crisp.

Clean the leaves
Rinse the fresh leaves thoroughly with clean water to remove dirt and contamiants.

Blend the Leaves: Place the fresh or dried leaves into a blender. Add a small amount of clean water to facilitate blending.

Blend Thoroughly: Blend until you get a smooth, green paste.

Strain the Mixture: Pour the blended neem paste through a fine mesh strainer or cheesecloth into a clean glass jar or container. Press or squeeze to extract as much liquid as possible.

Collect the Extract: The liquid collected is moringa leaf extract and seed priming should be done for 8hrs.

Preparation of Moringa leaf extract
Materials Needed
- Fresh moringa leaves
- Clean water
- Blender or mortar and pestle
- Fine mesh strainer or cheesecloth
- Glass jar or container

Steps
Harvest Fresh Leaves: If you are using fresh moringa leaves, pick them from the tree. Ensure they are clean and free of pests.

Drying (if using dried leaves): Spread the leaves out in a thin layer in a shaded, well-ventilated area until they are dry and crisp.

Clean the Leaves: Rinse the fresh leaves thoroughly with clean water to remove dirt and contaminants.

Blend the Leaves: Place the fresh or dried leaves into a blender.

Add a small amount of clean water to facilitate blending.

Blend Thoroughly: Blend until you get a smooth, green paste.

Strain the Mixture: Pour the blended moringa paste through a fine mesh strainer or cheesecloth into a clean glass jar or container. Press or squeeze to extract as much liquid as possible.

Collect the Extract: The liquid collected is moringa leaf extract and seed priming should be done for 8hrs.

Preparation of Tulsi leaf extract

Materials Needed

- Fresh or dried tulsi leaves
- Clean water
- Blender or mortar and pestle
- Fine mesh strainer or cheesecloth
- Glass jar or container

Steps

Harvest Fresh Leaves: Pick fresh tulsi leaves from the plant. Ensure they are clean and free of pests.

Drying (if using dried leaves): Spread the leaves out in a thin layer in a shaded, well-ventilated area until they are dry and crisp.

Clean the Leaves: Rinse the fresh leaves thoroughly with clean water to remove dirt and contaminants.

Blend the Leaves: Place the fresh or dried leaves into a blender. Add a small amount of clean water to facilitate blending.

Blend Thoroughly: Blend until you get a smooth, green paste.

Strain the Mixture: Pour the blended tulsi paste through a fine mesh strainer or cheesecloth into a clean glass jar or container. Press or squeeze to extract as much liquid as possible.

Collect the Extract: The liquid collected is tulsi leaf extract and seed priming should be done for 8hrs.

Results and Discussion

Field Emergence

There was significant difference among the treatments. However, highest field emergence (77.67) was recorded with the application of Phosphorous 60 kg/ha + Neem leaf extract 10%, and minimum was reported in control (64.85).

Plant height

At 80 DAS there was no significant difference among the treatments. However, highest plant height (56.1 cm) was recorded with the application of Phosphorous 60 kg/ha + Neem leaf extract 10%, and minimum was reported in control (47.8 cm). Increment in plant height might be due to improved biological activities in the presence of balanced supply of phosphorus. These results are in agreement with the findings of other researchers (Basir *et al* 2008, Gulpadiya *et al* 2014) [1, 10, 11] in chickpea.

Plant dry weight

There was significant difference among the treatments. However, highest dry weight (42.21 g) was recorded with the application of Phosphorous 60 kg/ha + Neem leaf extract 10%, whereas treatment Phosphorous 60 kg/ha + Moringa leaf extract 15% (40.99) and Phosphorous 60 kg/ha + Tulsi leaf extract 5% (40.38 g) were found to be statistically at par with and minimum was reported in Phosphorous 40 kg/ha + Tulsi leaf extract 5% (32.71 g). This might be the possible reason for better nodulation in phosphorus applied treatments. These findings are in line with those of Basir *et al* (2008) [1] and Gulpadiya *et al* (2014) [10, 11] who also reported enhancement in number of nodules with incremental levels of phosphorus.

Number of nodules per plant

At 80 DAS there was significant difference among the treatments. However, highest number of nodules per plant (30.5) was recorded with the application of Phosphorous 60 kg/ha + Neem leaf extract 10%, whereas treatment Phosphorous 60 kg/ha + Moringa leaf extract 15% (29.4) was found to be statistically at par with T_6, and minimum was reported in control (20:50:30) (19.5).

Number of branches per plant

Found no significant difference among the treatments. However, highest number of branches per plant (19.0) was recorded with the application of Phosphorous 60 kg/ha + Neem leaf extract 10%, and minimum was reported in Phosphorous 40 kg/ha + Moringa leaf extract 15% (16.2). The phosphorus application influences photosynthesis, biosynthesis of protein and phospholipids, nucleic acid synthesis, membrane transports, energy transformation and cell division of the plant system. The progressive increase in number of branches might be attributed to the role of phosphorus in better root development and proliferation, nodules formation and N2 fixation by supplying assimilates to the roots (Gulpadiya and Chhonkar 2014) [10, 11]. These results are in agreement with those of Das *et al* (2013) [17] in chickpea.

Seed yield (kg/ha)

The perusal of the data of Seed yield (kg/ha) was recorded at harvest, is presented in Table 1. The data reveals that there was a significant difference among the treatments of Seed yield and stover yield.

Significantly maximum seed yield (kg/ha) (2182.02 kg/ha) was recorded with the treatment in application of Phosphorous 60 kg/ha + Neem leaf extract 10% and minimum was recorded in control (25:50:30) (1957.77 kg/ha), whereas Phosphorous 60 kg/ha + Moringa leaf extract 15% (2113.90 kg/ha) was statistically at par with T_6.

Stover yield (kg/ha)

Significantly maximum stover yield (kg/ha) (3148.08 kg/ha) was recorded with the treatment in application of Phosphorous 60 kg/ha + Neem leaf extract 10% and minimum was recorded in control (25:50:30) (2977.80 kg/ha), whereas Phosphorous 60 kg/ha + Moringa leaf extract 15% (3110.05 kg/ha) was statistically at par with T_6.

Table 1: Effect of phosphorus and leaf extract spray on growth and yield of chickpea

S. No	Treatments	Field emergence	Plant height (80 DAS)	Plant dry weight (80 DAS)	Number of nodule per plant (80 DAS)	Number of branches per plant (80 DAS)	Seed yield (Kg/ha)	Stover yield
1.	Phosphorous 40 kg/ha + Tulsi leaf extract 5%	65.42	48.4	32.71	21.0	16.6	1985.70	2983.82
2.	Phosphorous 40 kg/ha + Moringa leaf extract 15%	66.67	49.2	34.46	21.5	16.2	1993.20	2909.14
3.	Phosphorous 40 kg/ha + Neem leaf extract 10%	67.58	49.8	34.61	21.9	16.8	2014.80	2973.78
4.	Phosphorous 60 kg/ha + Tulsi leaf extract 5%	77.21	52.9	40.38	25.7	17.5	2051.60	2994.67
5.	Phosphorous 60 kg/ha + Moringa leaf extract 15%	74.24	54.8	40.99	29.4	18.0	2113.90	3110.05
6.	Phosphorous 60 kg/ha + Neem leaf extract 10%	77.67	56.1	42.21	30.5	19.0	2182.02	3148.08
7.	Phosphorous 80 kg/ha + Tulsi leaf extract 5%	67.58	50.3	35.45	23.0	16.6	2032.20	3060.54
8.	Phosphorous 80 kg/ha + Moringa leaf extract 15%	68.48	51.3	35.47	23.7	16.9	2040.10	2960.47
9.	Phosphorous 80 kg/ha + Neem leaf extract 10%	69.39	52.0	37.51	24.7	16.8	2050.00	3036.67
10.	Control (25:50:30)	64.85	47.8	33.45	19.5	17.0	1957.77	2977.80
	SEm±	2.98	2.10	2.14	1.02	0.72	65.69	36.38
	CD (p=0.05)	8.85	-	6.36	3.03	-	195.18	108.1
	CV	7.38	7.09	10.10	7.33	2.15	5.57	2.09

Conclusion

It is concluded that application of Phoshporus 60 kg/ha with spraying of 10% Neem leaf extract (T_6) gave higher yield.

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