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Effect of foliar application of nutrients on growth and yield in Summer mungbean (*Vigna radiata* L.)

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Abstract
The field experiment was conducted on "Effect of foliar application of chemicals on growth and yield of summer green gram (*Vigna radiata* L. Wilczek)". During the summer season of the year 2020-21 at the research farm of Tirhut College of Agriculture, Dholi (Muzaffarpur). In this trial, eight treatments were used in a randomized block design and replicated three times and the variety used was HUM -16. As a result of the field study, it was found that green turf growth parameters, yield uptake and water conservation were significantly affected by the application of 2% NPK (19:19:19) spray at flower initiation and pod initiation was comparable with treatments such as T_6 (100 ppm salicylic acid), T_5 (2% potassium nitrate) and T_4 (0.2 ppm potassium chloride). However, the lowest parameter was observed in T_1 (control).

Keywords: Green gram, foliar application, yield, flower initiation and pod initiation

Introduction
In our country, one of the main crops known as "greengram" of our country has been grown for a long time (*Vigna radiata* L. Wilczek). In India, greengram (*Vigna radiata* L. Wilczek) is one of the most popular legumes, also known as "mung bean". It belongs to the Leguminosae family, genus Vigna, subgenus ceratotropis, and is one of the most common legumes. It has been cultivated by Indians since ancient times as a short-lived legume. Originally from India and Central Asia, green chickpea has spread to other parts of the world. In addition to seed, mung bean can also be used as green manure and fodder and is a very versatile crop. Worldwide, about 5.5 million hectares of green bean are grown each year. Foliar fertilization is more beneficial than soil fertilization because foliar fertilization requires much less fertilizer than soil fertilization. Fertilizer prices are constantly increasing, so it is necessary to reduce fertilizer use by using foliar fertilizers to reduce fertilizer costs. About 75% of the world's green kernel crop is produced in India, which is the world's largest green kernel producer. It is estimated that green kernel production in the country accounts for between 10 and 12% of total legume production (Anonymous, 2016) [2]. As a highly nutritious legume, it contains nearly 24 to 25% protein in its seed, making it a very nutritious food. Nutrients can be applied to pulses to increase their yields. During the kharif season in Maharashtra, dry spells of 15 to 35 days are common, resulting in reduced growth and yield of green grass. Foliar fertilization is one of the most efficient and quickest methods to fertilize plants, as it can reach as many plants as quickly as possible. There is good evidence that it prevents nutrient losses by inhibiting leaching of nutrients from the soil as well as the fixation of nutrients in the soil, and it regulates the uptake of nutrients by plants (Rahman *et al.*, 2014 and Manonmani and Srimathi, 2009) [12, 9]. For optimum utilization of nutrients and better crop production, it is important to apply foliar sprays of essential nutrients at the appropriate stages of plant growth. Foliar fertilizer application has been found to be the most effective method of applying plant nutrients in the form of foliar sprays because nutrients applied through the leaf penetrate the cuticle and stomata of the leaf and reach the cells very quickly, allowing rapid and effective nutrient utilization (Latha and Nadanassabady, 2003) [8]. In legumes, additional supply of nutrients is a crucial factor for increasing grain yield and also one of the most important areas of research. Plant nutrients can be supplied to the plant through the leaves to improve the nutrient efficiency of the plant. This is often the most cost effective and efficient method (Dixit and Elamathi, 2007) [4] to improve the nutrient efficiency of plants.

Materials and Methods

The research will be conducted during the 2020-21 summer season at the Tirhut College of Agriculture research farm in Dholi (Muzaffarpur). We conducted an experiment with a randomized block design where eight treatments with three replicates were applied and the variety used was Hum-16. Treatments included: T_1 - control (no spray), T_2 water spray at flower and pod initiation, T_3 - calcium chloride @ 0.1% spray at flower and pod initiation, T_4 - potassium chloride @ 0.2% spray at flower and pod initiation, T_5 - Potassium nitrate @ 2% spray at flower and pod initiation, T_6 - Salicylic acid 100 ppm spray at flower and pod initiation, T_7 - NPK (19:19:19) @ 2% spray at flower and pod initiation, and T_8 - Thiosalicylic acid 75 ppm spray at flower and pod initiation. By dissolving 20 g urea and 20 g DAP in 1 liter of water, a solution with a concentration of 2% was obtained by adding 1 liter of water to each. We dissolved the granules of DAP in a small amount of water and allowed the solution to settle overnight before diluting the supernatant solution with the remaining water for spraying. After spraying, the supernatant was removed for reuse. It was found that 0.1 g of salicylic acid could not dissolve in water. However, 0.1 g of salicylic acid was dissolved in a small amount of alcohol and then added to one liter of water to produce 100 ppm of salicylic acid. It is not soluble in water, so the production of salicylic acid involves mixing alcohol with one litre of water. Dissolving 0.5 g of sodium molybdate in one litre of water produced a solution of 0.05% sodium molybdate.

Results and Discussion

Several studies have been conducted on the effects of foliar applications of nutrients on green gram plants. As shown in Table 1, data on growth parameters were recorded. Under T_7 - treatment (NPK (19:19:19) @ 2% spray at flowering and pod initiation), significantly higher number of plants was observed as follows: Plant height (cm), dry weight per plant (g/plant), number of nodules per plant, all of which were comparable to T_6 - (salicylic acid 100 ppm), T_5 - (potassium nitrate @ 20%) and T_5 - (potassium chloride @ 0.2%) treatments. However, the lowest parameter was observed in T_1 (control). In addition to foliar application of nutrients, foliar application also has a positive effect on the uptake of macronutrients such as N, P, and K. Cell division and meristematic tissue development are important functions of mitochondria, including photosynthesis, respiration, and acceleration of plant physiology when roots do not take up nutrients. These results are similar to those of Geetha and Velayutham (2009) [5], Kumar *et al.* (2018) [7], and Phule *et al.* (2019) [11].

Table 1: Plant height (cm), Dry weight per plant (g/plant), and Number of nodules plant^{-1}, of green gram as influenced by foliar nutrition

Treatment	Plant height (cm)	Dry weight per plant (g/plant)	Number of nodules plant^{-1}
	At harvest	At harvest	40 DAS
T_1	36.24	8.50	15.49
T_2	38.57	11.74	17.79
T_3	39.19	13.16	17.97
T_4	42.47	13.58	18.69
T_5	42.49	15.27	20.50
T_6	42.63	15.57	20.74
T_7	44.66	15.69	21.52
T_8	39.52	13.40	18.42
SEm±	1.57	0.68	0.90
CD (P=0.05)	4.82	2.09	2.756

An evaluation of foliar nutrition's influence on the seed yield, stover yield, and harvest index of greengram

See Table 2 for seed yield data. A significant difference was found among the different treatments. Compared to the other treatments, T_7 - (NPK (19:19:19) @ 2% spray at the beginning of flowering and the beginning of pods) gave the highest grain yield (12.55 q ha^{-1}). In contrast, T_1 - (Absolute control) was observed to have the lowest grain yield (9.55 q ha^{-1}). Assimilate shift to the developing sink and increased dry matter production resulted in an increase in grain yield and pod production. As noted by Kulkarni *et al.* (2016) [6], these results are also consistent. According to the results of the stalk yield experiment, T_7 - (NPK (19:19:19) sprayed at 2% at flower and pod initiation produced the highest yield (25 q ha^{-1}). While superior to the other treatments, it was close to T_6 - (salicylic acid 100 ppm sprayed at flower and pod initiation) and T_5 - (potassium nitrate @ 2% sprayed at flower and pod initiation). Straw yield was lowest at T_1 - (control). In the different treatments, the increase in stalk yield could be due to the continuous nutrient supply, which resulted in an increase in leaf area and dry matter production, which in turn resulted in a higher stalk yield. As a result, the plant takes up most of the nutrients throughout the growing season. Navaz *et al.* (2017) [10] found similar results with greengram. As shown in Table 2, the harvest index data found a non-significant variation among the years studied.

In the study it was found that the maximum harvest index was recorded under genotype T_8 - (thiosalicylic acid spraying at a rate of 75 ppm during flowering and pod initiation). As a result, T_1 - (control) had the lowest harvest index among all treatments.

Table 2: Effect of foliar application of chemicals on grain yield, straw yield and harvest index of Greengram

Treatment	Grain yield(q/ha)	Straw yield (q/ha)	Harvest index (%)
T_1	9.55	19.78	32.58
T_2	9.9	20	33.1
T_3	10.06	21.02	32.33
T_4	10.90	22.33	32.80
T_5	11.16	22.43	33.22
T_6	11.26	22.88	32.94
T_7	12.25	25.0	32.28
T_8	10.71	21.0	33.77
SEm±	0.328	0.49	0.002
CD (P=0.05)	1.0	1.51	NS

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