Annals of Biology **39** (1) : 49-53, 2023

Impact Score : 0.32 (Scopus)

Impact of Seed Priming and Foliar Application of Nutrients Based Morpho-physiological Changes on Growth and Yield of Greengram (*Vigna radiata* L.)

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(Received: May 28, 2022; Accepted: June 29, 2022)

ABSTRACT

The present piece of work was considered to understand the impact of seed priming and foliar application of nutrients on morpho-physiological growth such as plant height, fresh and dry weight (g)/plant, the number of leaves, leaf area (cm^2)/plant, LAI, HI%, SPAD unit, yield and its attributes of greengram (*Vigna radiata* L.)/plant. The seeds were primed with salicylic acid and KNO_3, while urea and DAP were used as a foliar application for enhancing the growth of the entire plant contributing to the improvement of yield. Out of both the varieties, SML-668 (V_1) and Star-452 (V_2), V_2 was recorded best for most of the parameters as compared to V_1, while among the priming+foliar treatments, T_5 (KNO_3+1% urea) was recorded superior for all the parameters (90.70 cm, 128.90 and 15.88 g, 1.47, 35.93, 6.47, 29.14, 5.33, 26.33 and 13.07/plant) except to the number of leaves, leaf area/plant which was recorded better in T_6 (KNO_3+ 1% DAP; 49.00, 440.03 cm^2/plant) in V_2. However, a similar trend for the performance of treatments was recorded in V_2 (91.3 cm, 381.2 cm^2, 1.27, 32.5 and 6.10 g/plant) except for fresh and dry weight, the number of leaves, HI% and number of primary branches/plant, which were recorded as superior in T_6 (126.0, 15.67 g/plant, 45.7, 28.69%). Statistical analysis of data showed that all the parameters recorded significant differences at ($P>0.05$) except for HI%.

Key words: Diammonium phosphate, greengram, harvest index %, KNO_3, seed priming, urea

INTRODUCTION

Greengram (*Vigna radiata* L.) is a leguminous crop that is commonly known as mungbean and can fix atmospheric nitrogen at an average of 30-40 kg N/ha (Demeke *et al.*, 2020; Mishra *et al.,* 2022). The climatic conditions of India favour this crop to grow over the years (*kharif, rabi* and *zaid*). Seed priming is a controlled hydration process in the seeds up to a level that permits pre-germinative metabolic activity to proceed but prevents the actual emergence of the radical (Pandey *et al.,* 2017; Thongbam and Siddique, 2022). Salicylic acid is an extraordinarily diverse group of plant phenolic defined as a substance that possesses an aromatic ring bearing a hydroxyl group. It has a significant impact on photosynthesis, transpiration, mineral intake and transport in plant growth and development (Trivedi *et al.,* 2018; Nandan *et al.,* 2021). Currently, micronutrients are being used as a seed priming treatment and their positive impact influences the entire life of the plant system (Rasool *et al.,* 2019; Mondal and Bose, 2019). It is an easy and cost-effective method to nourish the seed consequently it returns in many ways such as accelerating the process of seed germination and establishment (Sime and Aune, 2020). Priming treatment with foliar application of nutrients significantly increases the yield of pulse crops by accelerating the initial growth phase such as seed germination and seedling growth, while foliar application of nutrients helps to maintain the balance between the source-sink relationship via improving the photosynthetic efficiency in the plant. Consequently, it reflects in improved HI% (Nadeem *et al.,* 2020; Kumari *et al.,* 2021; Banerjee *et al.,* 2022).

MATERIALS AND METHODS

A field experiment was planned and executed over the research farm of Lovely Professional University in the *kharif* season of 2021-22. To determine the impact of treatments on the morphological growth and yield of greengram, the experiment was laid out in FRBD and replicated thrice in which two varieties (SML 668 and Star 452) were comprised in the five different combinations of priming (salicylic acid and KNO_3) and foliar application of nutrient (Urea and DAP in % concentration), while one set without treatment was used as a control for both the varieties (V_1T_0 and V_2T_0). The recommended dose of fertilizer 20 : 40 : 20 kg of NPK/ha was applied through urea, SSP and MOP, while the standard agronomical practices were applied for the smooth conductance of the trial. The priming agents, SA and KNO_3, were used in 3 mM and KNO_3 15 mM concentration for the constant duration which was 8 h. The morphological, as well as yield and yield-related parameters, were recorded as per the standard protocol, while to compute the parameters like leaf area, LAI and HI%, the standard leaf area meter (Model No. 211) and the formula was used as given below:

LAI= Total leaf area (cm^2)/Total ground area (cm^2)

HI% = (Economic yield/Biological yield) × 100

To measure the SPAD (Model No. 502) reading representing the parameter of chlorophyll, a SPAD meter was used at the time of observation. FRBD analysis was carried out through SPSS Model No. 23, while the significance level was checked at P>0.5%.

RESULTS AND DISCUSSION

The varietal response showed that variety V_2 (Star 452) performed well as compared to another variety V_1 (SML 668). Among the seed priming treatments, T_6 (KNO_3+1% DAP) was recorded best for all the parameters with fresh and dry weight 134 and 15.79 g/plant except to plant height which was recorded better in T_5 (KNO_3+1% urea) 91.3 cm in V_1 (Table 1). However, the performance of the V_2 treatment was almost the same as in V_1. The parameters of plant height and dry weight of plant were recorded superior in T_5 (90.70 cm and 15.88 g/plant), while fresh weight was recorded in T_5 (135.25 g/plant) in V_2 which was followed by

Table 1. Effect of seed priming and foliar application of nutrients on plant height (cm), fresh weight (g) and dry weight (g) of greengram

Treatment		Plant height (cm)	Fresh weight (g)	Dry weight (g)
V_1	T_0	71.3±0.89^a	94.0±1.90^a	13.23±0.28^a
	T_1	81.8±0.89^{cde} (12.83)	99.3±1.91^{bc} (5.32)	13.25±0.48^{ab} (0.19)
	T_2	85.8±1.04^{cde} (16.86)	113.1±1.46^{de} (16.86)	13.96±0.37^{ab} (5.25)
	T_3	83.5±1.20^{cd} (14.57)	115.1±2.15^{de} (18.30)	14.28±0.55^{abc} (7.36)
	T_4	87.8±2.65^{cde} (18.75)	103.8±3.63^c (9.48)	14.68±0.63^{abcd} (9.93)
	T_5	91.3±6.46^e (21.90)	126.0±1.74^f (25.42)	15.67±0.72^{cd} (15.59)
	T_6	88.4±3.17^{cde} (19.34)	134.0±1.68^g (29.83)	15.79±0.92^{cd} (16.25)
V_2	T_0	76.0±0.58^{ab}	95.8±0.45^{ab}	13.43±0.60^a
	T_1	81.6±0.81^{bc} (6.90)	111.1±0.69^d (13.70)	13.76±0.35^a (2.41)
	T_2	84.6±1.48^{cde} (10..17)	115.1±0.90^{de} (16.75)	13.96±0.37^{ab} (3.81)
	T_3	83.0±2.20^{bcd} (8.47)	116.9±1.25^e (18.03)	16.29±0.29^d (17.58)
	T_4	87.4±1.48^{cde} (13.04)	118.3±0.85^e (18.96)	15.53±0.50^{bcd} (13.56)
	T_5	90.70±1.73^{de} (16.21)	128.90±0.70^f (25.65)	15.88±0.33^{cd} (15.47)
	T_6	88.23±0.61^{cde} (13.86)	135.25±0.50^g (29.14)	15.79±0.36^{cd} (14.98)
C. D.		6.699	5.081	1.465
C. V.		4.698	2.648	5.923

V_1T_0–Control, V_1T_1–SA, V_1T_2–SA+1% urea, V_1T_3–SA+1% DAP, V_1T_4–KNO_3, V_1T_5–KNO_3+1% urea, V_1T_6–KNO_3+1% DAP, V_2T_0–Control, V_2T_1–SA, V_2T_2–SA+1% urea, V_2T_3–SA+1% DAP, V_2T_4–KNO_3, V_2T_5–KNO_3+1% urea and V_2T_6–KNO_3 +1% DAP. Data presented in parentheses show % increase and decrease over control.

T_6. Data presented in parentheses of Table 1 also reveal the % increase and decrease over control which showed a direct difference among the treatments. The results of data presented in parentheses reveal the same trend for both the varieties as well as priming treatments. Data presented in Table 2 revealed the impact of seed priming and foliar application of nutrients on the number of leaves, leaf area (cm^2) and leaf area index of greengram. The varietal response showed that variety V_2 performed well as compared to variety V_1. Among the seed priming treatments, T_5 (KNO_3+1% urea) was recorded best for all the parameters which were leaf area and LAI 381.2 cm^2 and 1.27 except for the number of leaves which was recorded better in T_6 (KNO_3+1% DAP) 47 in V_1. However, the performance of the V_2 treatment was almost the same as in V_1. The parameters of leaf area and LAI of the plant were recorded superior in T_5 at 4.40.03 cm^2 and 1.47, while the number of leaves was recorded in T_6 at 49 in V_2 which was followed by T_6. The results of data presented in parentheses revealed the impact of treatments that were recorded for the respective parameters.

Data regarding the yield attribute showed that among the priming treatments in V_1 and V_2, number of primary branches, number and length of pod/plant were recorded maximum in T_5 (5.33, 26.33, 13.07 and 27.33, 14.27) in V_1 and V_2 (Table 3). Data presented in Fig. 1 show the impact of seed priming and foliar application of nutrients on the SPAD reading, grain yield and HI%. The varietal response showed that variety V_2 performed well as compared to variety V_1. Among the seed priming treatments, T_5 was recorded best for all the parameters which were SPAD and grain yield 32.5 and 6.10 g/plant except for the HI % which was recorded highest in T_6 at 28.69% in V_1. However, the performance in the V_2 was recorded differently as compared to V_1. All the parameters (Fig. 1) were recorded highest in T_5 at 35.93, 6.47 and 29.14%. The results of the data presented in parentheses also support the impact of the treatments which were

Table 2. Effect of seed priming and foliar application of nutrients on number of leaves, leaf area (cm^2) and leaf area index of greengram

Treatment		No. of leaves	Leaf area (cm^2)	LAI
V_1	T_0	36.7±0.89a	324.4±6.19^b	1.081±0.03^b
	T_1	37.0±2.52a	337.0±1.84^{bc}	1.123±0.01^{bc}
		(0.90)	(7.97)	(7.97)
	T_2	41.0±2.89^{abc}	342.9±5.3^{cd}	1.143±0.02^{cd}
		(10.57)	(9.55)	(9.55)
	T_3	42.0±1.74^{abcd}	362.8±3.09^a	1.209±0.02^{ef}
		(12.70)	(14.51)	(14.51)
	T_4	39.3±4.06^{ab}	310.1±6.45^{gh}	1.034±0.03^a
		(6.78)	(4.39)	(4.39)
	T_5	45.7±1.21^{bcd}	381.2±4.20^{gh}	1.271±0.02^{gh}
		(19.71)	(18.65)	(18.65)
	T_6	47.0±2.0^{cd}	372.7±5.33^{fg}	1.242±0.02^{fg}
		(21.99)	(16.79)	(16.79)
V_2	T_0	37.3±2.73^a	334.8±1.70^{bc}	1.116±0.01^{bc}
	T_1	38.7±1.46^{ab}	352.7±3.66^{de}	1.176±0.02^{de}
		(3.45)	(5.08)	(5.08)
	T_2	42.3±1.21^{abcd}	411.0±3.83^i	1.370±0.02^i
		(11.81)	(18.54)	(18.54)
	T_3	43.7±2.34^{abcd}	388.3±6.47^h	1.294±0.03^h
		(14.50)	(13.78)	(13.78)
	T_4	43.0±2.09^{abcd}	393.9±5.92^h	1.313±0.02^h
		(13.18)	(15.01)	(15.01)
	T_5	46.67±2.03^{cd}	440.03±4.63^j	1.467±0.02^j
		(20.0)	(23.92)	(23.92)
	T_6	49.00±0.58^d	427.53±2.39^j	1.425±0.01^j
		(23.81)	(21.69)	(21.69)
C. D.		6.75	14.44	0.048
C. V.		9.58	2.33	2.329

Treatment details are given in Table 1.

Table 3. Effect of seed priming and foliar application of nutrients on number of primary branches, number of pods and length of pod/plant in greengram

Treatment		No. of primary branches/plant	No. of pods/plant	Length of pod/plant
V_1	T_0	3.67±0.34^{a}	19.33±2.03^{a}	8.00±0.58^{a}
	T_1	3.67±0.34^{a} (0.00)	20.00±1.0^{ab} (3.33)	10.17±0.17^{cd} (21.31)
	T_2	4.33±0.34^{ab} (15.38)	24.00±2.31^{cdef} (19.44)	11.07±0.98^{cdef} (27.71)
	T_3	4.33±0.34^{ab} (15.38)	21.00±1.53^{abc} (7.94)	9.83±0.45^{bc} (18.64)
	T_4	4.67±0.34^{abc} (21.43)	24.67±0.89^{def} (21.62)	11.67±0.34^{defg} (31.43)
	T_5	5.33±0.34^{bc} (31.25)	26.33±0.89^{ef} (26.58)	13.07±0.39^{ghi} (38.78)
	T_6	5.33±0.34^{bc} (31.25)	25.33±0.67^{def} (23.68)	12.17±0.87^{efgh} (34.25)
V_2	T_0	4.00±0.58^{a}	20.67±0.34^{abc}	8.33±0.34^{ab}
	T_1	4.00±0.01^{a} (0.0)	22.33±0.67^{abcd} (7.46)	10.67±0.34^{cde} (21.88)
	T_2	4.67±0.34^{abc} (14.29)	26.00±0.58^{def} (20.51)	11.50±0.58^{cdefg} (27.54)
	T_3	4.67±0.34^{abc} (14.29)	23.33±0.34^{bcde} (11.43)	10.70±0.41^{cde} (22.12)
	T_4	4.67±0.34^{abc} (14.29)	25.67±0.34^{def} (19.48)	12.57±0.64^{fgh} (33.69)
	T_5	5.33±0.34^{bc} (25.0)	27.33±0.89^{f} (24.39)	14.27±0.39^{i} (41.59)
	T_6	5.67±0.34^{c} (29.41)	26.67±0.89^{ef} (25.50)	13.40±0.16^{hi} (37.81)
C. D.		1.04	3.31	1.64
C. V.		13.56	8.28	8.74

Treatment details are given in Table 1.

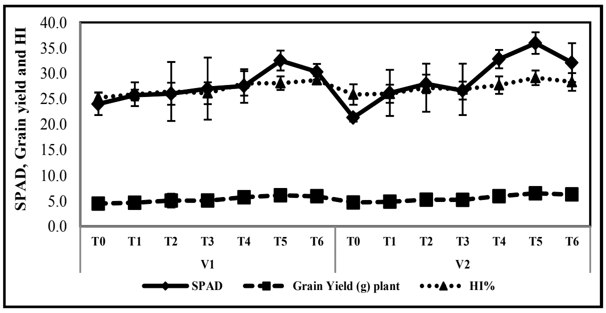

Fig 1. Effect of seed priming and foliar application of nutrients on SPAD readings, grain yield (g/plant) and harvest index (HI %) of greengram.

recorded for the respective parameters. Results of the ANOVA showed that all the parameters were highly significant at P>0.5% except for HI% even though the Duncan test was also carried out for all the parameters to know the status of significance among the treatments which was represented by alphabets. The similar alphabet among the treatments showed non-significance of the treatments, while different showed the significance of the treatments.

The yield of the pulse crop depends upon the vigorous growth of the plant from the emergence and maintenance of the initial plant population to the harvesting of the plant. Out of entire plant phases, plant height, fresh and dry weight, number of leaves, leaf area, LAI, HI%, SPAD reading and finally grain yield were recorded in the present work under the influence of seed priming and foliar application nutrients in greengram. It was observed from the data presented (Tables 1 and 2) that T_6 (KNO_3+1% FA of DAP) was recorded one of the best treatments for most of the parameters in V_1, while T_5 (KNO_3+1% FA of DAP) was recorded better for most of the parameters in V_2. The results of the present study are well correlated with the findings of Krishna and Kaleeswari (2018) who reported that potassium and foliar application of DAP played an important role in pulse to improve the physiological, yield and chlorophyll content. Enough literature is available regarding the KNO_3 in support of seed germination and initial growth (Shafiq *et al.*, 2015; Maheswari and Karthik, 2017) and foliar application of DAP and urea in pulse crop helped to enhance the yield and yield attributing character via interacting with chlorophyll content via improving the partitioning of photosynthate from source to sink which reflected the betterment of yield in pulse crop (Das and Jana, 2015; Maheswari and Karthik, 2017).

CONCLUSION

Greengram is very a healthy and nutritious pulse crop for human beings as well as for animals also. Therefore, the demand for this crop is always in the market but due to its poor growth and yield in the field, it is necessary to nourish the seeds through a priming agent along with the foliar application of DAP and urea before the flowering so that morphological growth and yield attributes may enhance yield of this valuable crop.

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