The Andhra Agric. J 73 (2): 213-217, 2026
doi :10.61657/aaj.2026.277

Effect of hormones and nutrients on yield and yield attributes of blackgram (*Vigna mungo* L.) affected by urdbean leaf crinkle disease

M Gowtam, K Jayalalitha, T Sujatha and P Kishore Varma
Department of Plant Physiology, Acharya N G Ranga Agricultural University,
Agricultural College, Bapatla - 522101, Andhra Pradesh, India

ABSTRACT

A field experiment was conducted to evaluate the influence of selected hormones and micronutrients on yield and yield attributes of blackgram affected by Urdbean Leaf Crinkle Disease (ULCD) at the Agricultural College Farm, Bapatla, Andhra Pradesh, during *rabi* 2025–26. The experiment was laid out in a Randomized Block Design with eleven treatments and three replications. Treatments consisted of seed treatment and foliar application of salicylic acid, jasmonic acid, naphthalene acetic acid (NAA), zinc sulphate and borax at different schedules. Yield parameters such as number of pod clusters per plant, number of pods per plant, pod weight, test weight, seed yield and haulm yield were recorded at harvest. The results revealed significant differences among the treatments for most of the yield attributes. Seed treatment with 100 ppm salicylic acid followed by foliar spray at 150 ppm applied at 20 and 40 DAS recorded the highest number of pod clusters, number of pods, pod weight, seed yield and haulm yield and was statistically on par with seed treatment with 50 µM jasmonic acid followed by foliar spray at 100 µM applied at 20 and 40 DAS. Although test weight showed numerical variation among treatments, the differences were not significant. The untreated control recorded the lowest values for all yield parameters. Improved yield under salicylic acid and jasmonic acid treatments could be attributed to reduced disease severity, maintenance of photosynthetic efficiency and enhanced assimilate partitioning towards reproductive sinks. The study demonstrated that application of salicylic acid or jasmonic acid as seed treatment followed by two foliar sprays effectively minimized yield losses due to ULCD and improved productivity of blackgram.

Key Words: *Blackgram, Jasmonic acid, Salicylic acid and Urdbean leaf crinkle disease*

Blackgram (*Vigna mungo* L. Hepper) is one of the major pulse crops cultivated in India owing to its high protein content, short duration and adaptability to diverse cropping systems. Besides serving as an important source of dietary protein, the crop improves soil fertility through biological nitrogen fixation. However, its productivity is considerably affected by several biotic stresses, among which Urdbean Leaf Crinkle Disease (ULCD) is one of the most destructive viral diseases causing severe reductions in growth, pod formation and seed yield. Yield losses ranging from 35 to 81 per cent have been reported depending on the stage of infection and disease severity.

Management of ULCD is challenging because effective curative measures are not available after virus establishment. Conventional practices such as vector management and cultivation of resistant varieties often provide inconsistent or limited control under field conditions. Therefore, eco-friendly approaches capable of enhancing the natural defense mechanisms of plants have gained considerable attention for minimizing disease-induced yield losses.

Among the available approaches, plant growth regulators and micronutrients have shown promise in improving plant tolerance against viral diseases. Salicylic acid induces systemic acquired resistance, while jasmonic acid regulates defense signaling pathways associated with stress tolerance. Naphthalene acetic acid (NAA) influences growth and physiological processes, whereas zinc and boron play important roles in enzyme activation, membrane stability, reproductive development and overall plant productivity. Earlier studies have reported that

application of these compounds reduced disease severity and improved crop performance under viral stress conditions.

Although the beneficial effects of individual hormones and nutrients have been reported, information on their comparative influence on yield and yield attributes of blackgram under Urdbean Leaf Crinkle Disease is limited. Therefore, the present investigation was undertaken to evaluate the effect of different hormone and nutrient treatments on yield and yield attributes of blackgram affected by Urdbean Leaf Crinkle Disease under field conditions.

MATERIAL AND METHODS

A field experiment was conducted during rabi 2025–26 at the Agricultural College Farm, Bapatla, Andhra Pradesh, to evaluate the effect of hormones and nutrients on yield and yield attributes of blackgram affected by Urdbean Leaf Crinkle Disease (ULCD). The experiment was laid out in a Randomized Block Design (RBD) with 11 treatments and three replications using blackgram variety LBG-904. The treatments consisted of seed treatment and foliar application of salicylic acid, jasmonic acid, naphthalene acetic acid (NAA), zinc sulphate and borax at different schedules. Foliar sprays were imposed at 20 DAS or 20 and 40 DAS according to the treatment schedule, while untreated plants served as the control. Observations on number of pod clusters plant^{-1}, number of pods plant^{-1}, pod weight (g plant^{-1}), test weight (g) and seed yield (kg ha^{-1}) were recorded at harvest. The experimental data were subjected to analysis of variance (ANOVA) appropriate for a Randomized Block Design, and treatment means were compared at the 5 per cent level of significance.

RESULTS AND DISCUSSION

Number of pod clusters per plant

The number of pod clusters per plant was significantly influenced by different hormone and nutrient treatments (Table 1). Seed treatment with 100 ppm salicylic acid followed by foliar spray @ 150

Table 1. Effect of hormones and nutrients on pod clusters per plant and pods per plant in blackgram affected by urdbean leaf crinkle disease

Treatments	Yield and Yield attributes									
	No. of pod clusters/plant					No. of pods/plant				
	H	%IC	D	%IC	%IR	H	%IC	D	%IC	%IR
T_1 : Seed treatment with 100 ppm salicylic acid + Foliar spray @ 150 ppm at 20 DAS	13.1	36.2	10.2	61.4	22.2	35.1	24.4	26.9	31.9	23.3
T_2 : Seed treatment with 50 µM jasmonic acid + Foliar spray @ 100 µM at 20 DAS	13.1	36.5	10.3	63.5	21.4	34.8	23.3	26.8	31.4	22.9
T_3 : Seed treatment with 20 ppm NAA + Foliar spray @ 40 ppm at 20 DAS	11.6	20.8	7.1	12.7	38.8	31.7	12.5	24	17.8	24.3
T_4 : Seed treatment with 0.05% $ZnSO_4$ + Foliar spray @ 0.5 % at 20 DAS	12	25.3	8.2	30.2	31.8	34.2	21.4	24.9	22.1	27.3
T_5 : Seed treatment with 0.01 % Borax + Foliar spray @ 0.2 % at 20 DAS	12.1	26.4	7.8	23.8	35.7	33.9	20.2	24.8	21.7	26.8
T_6 : Seed treatment with 100 ppm salicylic acid + Foliar spray @ 150 ppm at 20 and 40 DAS	15.6	62.5	11.5	82.1	26.5	39.6	40.4	31.1	52.6	24.3
T_7 : Seed treatment with 50 µM jasmonic acid + Foliar spray @ 100 µM at 20 and 40 DAS	15	56.3	11.1	75.7	26.2	40.6	44	30	46.9	23.3
T_8 : Seed treatment with 20 ppm NAA + Foliar spray @ 40 ppm at 20 and 40 DAS	12.3	28.4	9.3	47.6	24.6	34.3	21.5	26.3	28.8	23.3
T_9 : Seed treatment with 0.05% $ZnSO_4$ + Foliar spray @ 0.5 % at 20 and 40 DAS	12.5	29.9	9.97	58.3	20.1	34.5	22.5	25.7	25.8	25.7
T_{10} : Seed treatment with 0.01 % Borax + Foliar spray @ 0.2 % at 20 and 40 DAS	12.3	28.4	8.7	38.1	29.4	33.8	19.9	24.6	20.7	27.1
T_{11} : Control (untreated)	9.6		6.3			28.2		20.4		
CD (5%)	2.07		1.13			5.43		3.9		
CV (%)	9.61		7.25			9.22		8.81		

%IC – PER CENT INCREAESE OVER CONTROL %IR – PER CENT REDUCTION OVER HEALTHY

ppm at 20 and 40 DAS (T_6) recorded the highest number of pod clusters under both healthy and diseased conditions and was on par with 50 µM jasmonic acid applied as seed treatment and foliar spray @ 100 µM at 20 and 40 DAS (T_7). The untreated control (T_{11}) recorded the lowest number of pod clusters. The increased pod cluster formation under salicylic acid and jasmonic acid treatments might be due to reduced disease severity, improved flowering and efficient assimilate translocation to reproductive organs. These findings are in agreement with Bahadur *et al*. (2015), Karthikeyan *et al*. (2009) and Rehman *et al*. (2023).

Number of pods per plant

Hormone and nutrient treatments significantly influenced the number of pods per plant under both healthy and diseased conditions (Table 1). Seed treatment with 100 ppm salicylic acid followed by foliar spray @ 150 ppm at 20 and 40 DAS (T_6) recorded the highest number of pods per plant and was on par with 50 µM jasmonic acid applied as seed treatment and foliar spray @ 100 µM at 20 and 40 DAS (T_7). The untreated control (T_{11}) recorded the lowest number of pods per plant. The increased pod number under salicylic acid and jasmonic acid treatments might be attributed to reduced disease severity, improved flowering and better assimilate partitioning towards reproductive organs. Similar findings were reported by Sharma *et al*. (2015), Devi *et al*. (2024) and Rehman *et al*. (2023).

Pod weight (g plant^{-1})

Significant differences were observed among the treatments with respect to pod weight under both healthy and diseased conditions (Table 2). Seed treatment with 100 ppm salicylic acid followed by foliar spray @ 150 ppm at 20 and 40 DAS (T_6) recorded the highest pod weight and was on par with 50 µM jasmonic acid applied as seed treatment and foliar spray @ 100 µM at 20 and 40 DAS (T_7). The untreated control (T_{11}) recorded the lowest pod weight. Higher pod weight under salicylic acid and jasmonic acid treatments might be attributed to improved pod filling,

Table 2. Effect of hormones and nutrients on pod weight (g plant^{-1}) and test weight (g) in blackgram affected by urdbean leaf crinkle disease

Treatments	Yield and Yield attributes									
	Pod weight (g plant^{-1})					Test weight (g)				
	H	%IC	D	%IC	%IR	H	%IC	D	%IC	%IR
T_1 : Seed treatment with 100 ppm salicylic acid + Foliar spray @ 150 ppm at 20 DAS	18.2	50.7	14.7	61	19.4	4.1	34.6	3.5	22	15.3
T_2 : Seed treatment with 50 µM jasmonic acid + Foliar spray @ 100 µM at 20 DAS	18.4	52.3	14.2	55.9	22.8	4.1	32.7	3.5	21	14.8
T_3 : Seed treatment with 20 ppm NAA + Foliar spray @ 40 ppm at 20 DAS	15.2	25.4	10.3	12.5	32.3	3.9	25.8	3.2	10.5	17.9
T_4 : Seed treatment with 0.05% $ZnSO_4$ + Foliar spray @ 0.5 % at 20 DAS	15.7	29.8	11	20.5	29.9	3.9	27.1	3.5	22	10.3
T_5 : Seed treatment with 0.01 % Borax + Foliar spray @ 0.2 % at 20 DAS	13.9	14.6	11.2	23	19.1	3.6	19	3	5.24	17.3
T_6 : Seed treatment with 100 ppm salicylic acid + Foliar spray @ 150 ppm at 20 and 40 DAS	20.6	70.5	16.8	75.6	21.5	4.9	60.1	4	40.9	17.8
T_7 : Seed treatment with 50 µM jasmonic acid + Foliar spray @ 100 µM at 20 and 40 DAS	21.4	76.9	16	84	22.3	4.7	54.6	3.9	36	17.8
T_8 : Seed treatment with 20 ppm NAA + Foliar spray @ 40 ppm at 20 and 40 DAS	17.7	46.3	13.3	46	24.7	4.1	33.7	3.5	21.3	15.2
T_9 : Seed treatment with 0.05% $ZnSO_4$ + Foliar spray @ 0.5 % at 20 and 40 DAS	17.2	42.4	12.8	40.5	25.5	4	29.1	3.4	18.2	14.4
T_{10} : Seed treatment with 0.01 % Borax + Foliar spray @ 0.2 % at 20 and 40 DAS	16.4	35.8	12	31.1	27.2	3.8	25.5	3.4	19.9	10.7
T_{11} : Control (untreated)	12.1		9.13			3.1		2.9		
CD (5%)	2.81		1.62			NS		NS		
CV (%)	9.72		7.4							

%IC – PER CENT INCREAESE OVER CONTROL %IR – PER CENT REDUCTION OVER HEALTHY

enhanced assimilate translocation and reduced adverse effects of Urdbean Leaf Crinkle Disease. Similar results were reported by Sharma *et al*. (2015), Kothule *et al*. (2003) and Rehman *et al*. (2023).

Test weight (g)

No significant differences were observed among the hormone and nutrient treatments with respect to test weight under both healthy and diseased conditions (Table 2). However, salicylic acid applied as seed treatment followed by foliar spray @ 150 ppm at 20 and 40 DAS (T_6) recorded the highest test weight, while the untreated control (T_{11}) recorded the lowest values. The non-significant variation indicated that hormone and nutrient treatments had little influence on seed weight under Urdbean Leaf Crinkle Disease conditions. Similar observations were reported by Devi *et al*. (2024) and Srivastava *et al*. (2023).

Seed yield (kg ha^{-1})

Seed yield was significantly influenced by the hormone and nutrient treatments (Table 3). Seed treatment with 100 ppm salicylic acid followed by foliar spray @ 150 ppm at 20 and 40 DAS (T_6) recorded the highest seed yield and was on par with 50 µM jasmonic acid applied as seed treatment and foliar spray @ 100 µM at 20 and 40 DAS (T_7). The untreated control (T_{11}) recorded the lowest seed yield. The higher seed yield obtained with salicylic acid and jasmonic acid treatments might be attributed to reduced disease severity and improvement in yield-contributing characters, resulting in better assimilate partitioning towards seed development. Similar findings were reported by Sahni and Prasad (2022), Islam *et al*. (2002) and Rehman *et al*. (2023).

Haulm yield (kg ha^{-1})

Haulm yield was significantly influenced by the hormone and nutrient treatments (Table 3). Seed treatment with 100 ppm salicylic acid followed by foliar spray @ 150 ppm at 20 and 40 DAS (T_6) recorded the highest haulm yield and was on par with 50 µM jasmonic acid applied as seed treatment and foliar spray @ 100 µM at 20 and 40 DAS (T_7). The untreated

Table 3. Effect of hormones and nutrients on Seed yield (kg ha^{-1}) and Haulm yield (kg ha^{-1}) in blackgram affected by urdbean leaf crinkle disease

Treatments	Yield and Yield attributes			
	Seed yield (kg ha^{-1})	%IC	Haulm yield (kg ha^{-1})	%IC
T_1 : Seed treatment with 100 ppm salicylic acid + Foliar spray @ 150 ppm at 20 DAS	1005.67	17.5	1810.3	17.5
T_2 : Seed treatment with 50 µM jasmonic acid + Foliar spray @ 100 µM at 20 DAS	1000.67	16.9	1801.3	16.9
T_3 : Seed treatment with 20 ppm NAA + Foliar spray @ 40 ppm at 20 DAS	984.33	15.0	1771.7	15.0
T_4 : Seed treatment with 0.05% $ZnSO_4$ + Foliar spray @ 0.5 % at 20 DAS	993.33	16.0	1788.0	16.1
T_5 : Seed treatment with 0.01 % Borax + Foliar spray @ 0.2 % at 20 DAS	905.00	5.72	1629.0	5.73
T_6 : Seed treatment with 100 ppm salicylic acid + Foliar spray @ 150 ppm at 20 and 40 DAS	1146.67	34.0	2064.0	34.0
T_7 : Seed treatment with 50 µM jasmonic acid + Foliar spray @ 100 µM at 20 and 40 DAS	1056.67	23.4	1902.0	23.5
T_8 : Seed treatment with 20 ppm NAA + Foliar spray @ 40 ppm at 20 and 40 DAS	985.00	15.1	1773.0	15.1
T_9 : Seed treatment with 0.05% $ZnSO_4$ + Foliar spray @ 0.5 % at 20 and 40 DAS	993.33	16.0	1788.0	16.1
T_{10} : Seed treatment with 0.01 % Borax + Foliar spray @ 0.2 % at 20 and 40 DAS	988.33	15.5	1779.0	15.5
T_{11} : Control (untreated)	856.00		1540.7	
CD (5%)	127.03		224.02	
CV (%)	7.52		7.36	

control (T_{11}) recorded the lowest haulm yield. The higher haulm yield obtained under salicylic acid and jasmonic acid treatments might be attributed to reduced disease severity, maintenance of photosynthetic activity and enhanced dry matter accumulation, resulting in greater biomass production. Similar findings were reported by Devi *et al*. (2024), Sahni and Prasad (2022) and Rehman *et al*. (2023).

CONCLUSION

The present investigation demonstrated that hormone and nutrient treatments significantly improved the yield and yield attributes of blackgram affected by Urdbean Leaf Crinkle Disease. Among the treatments, seed treatment with 100 ppm salicylic acid followed by foliar spray @ 150 ppm at 20 and 40 DAS (T_6) proved to be the most effective, recording superior performance for pod clusters per plant, pods per plant, pod weight and seed yield, and was statistically on par with 50 µM jasmonic acid applied as seed treatment followed by foliar spray @ 100 µM at 20 and 40 DAS (T_7). The findings indicate that the application of salicylic acid or jasmonic acid can effectively reduce yield losses and enhance productivity of blackgram under Urdbean Leaf Crinkle Disease conditions.

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Received on 05.04.2026 and Accepted on 08.05.2026