



Research Article

IMPACT OF FOLIAR NUTRITION ON PRODUCTIVITY AND PROFITABILITY OF GREEN GRAM (*Vigna radiata* L.)

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Abstract: A field experiment was conducted at Birsa Agricultural University, Ranchi, Jharkhand during the kharif seasons of 2016 and 2017 with the main objective to study the effect of foliar application of combinations of different compounds on growth, yield and economics of green gram under rainfed condition. It comprised of ten treatments viz., water spray(control), Urea @ 2% spray, TNAU Pulse Wonder @ 1% spray, Salicylic acid @ 75ppm spray (two times), 19:19:19 (N:P:K) @ 2% spray, Urea @ 2% + Salicylic acid @ 75ppm spray, Boron @ 250ppm spray, Nitrobenzene @ 500ppm spray, DAP @ 2% spray (two times) and KCl 2% spray. Two years data revealed that application of Urea @ 2% + Salicylic acid @ 75ppm through foliar spray at flower initiation stage of green gram along with recommended dose of fertilizer(20:40:20:20 kg N:P₂O₅:K₂O:S/ha) improved green gram grain yield, yield attributing characters, viz. number of pods/plant, number of seeds/pod, number of branches/plant, 100 seed weight and growth parameters, viz. plant height, dry matter accumulation and leaf area index(LAI). Highest plant height (70.27 cm), number of nodules per plant(34.11), LAI (4.5), DMA (313.47 g/m²), number of branches/plant(8.04), LAI (4.5), number of pods/plant (16.0), seeds/pod (14.4), 100 seed weight (3.47g), grain yield (1099 kg/ha), net return (₹35,407.00/ha) and B: C ratio (1.88) of green gram was recorded with application of Urea @ 2% + Salicylic acid @ 75ppm which enhanced grain yield upto 34% being at par with foliar application of 2% (N:P:K::19:19:19) or 2% Urea along with recommended dose of fertilizer(20:40:20:20 kg N:P₂O₅:K₂O:S/ha).

Keywords: Growth, Yield and economics of Green gram

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Introduction

Pulses are commonly known as food legumes which are next to cereals in production and consumption in India. India is the largest producer and consumer of pulses in the world with the production of 19.8 m tonnes from an area of 25.21 m ha with a short supply of around 2-3 million tonnes annually [1]. Thus, India needs to import pulses every year to fulfil the domestic demand. In India, green gram is the third most important pulse crop grown in area of 3.42 mha with production of 1.72 mtonnes. The present productivity of green gram of 696 kg ha⁻¹ is far below the potential and provides substantial scope for improvement with the adoption of improved technologies. Apart from the genetic makeup, the physiological factor viz., insufficient partitioning of assimilates, poor pod setting due to the flower abscission and lack of nutrients during critical stages of crop growth, coupled with several diseases and pests [2] were the reasons for the poor yield. Foliar feeding is often the most effective and economical way to improve plant nutrient deficiency [3]. Among various factors, application of nutrients through foliar application which increases the fertilizer use efficiency, thus increasing yield and reducing cost of production in pulses is gaining importance. Supplemental nutrition plays a crucial role in increasing seed yield in pulses [4]. Though foliar spray is not a substitute to soil application, but it certainly be considered as a supplement to soil application.

Materials and Methods

A field experiment was conducted on representative medium land soil of Jharkhand plateau at Birsa Agricultural University, Kanke, Ranchi during the kharif season 2016 and 2017 with the main emphasis to study the effect of foliar nutrition on growth, yield, quality and economics of green gram in an acid soil. The experiment was laid out in a Randomized Block Design with ten treatments replicated thrice and the variety was SML 668.

The treatments were: water spray(control), Urea @ 2% spray, TNAU Pulse Wonder @ 1% spray, Salicylic acid @ 75ppm spray (two times), 19:19:19 (N:P:K) @ 2% spray, Urea @ 2% + Salicylic acid @ 75ppm spray, Boron @ 250ppm spray, Nitrobenzene @ 500ppm spray, DAP @ 2% spray (two times) and KCl 2% spray. A uniform dose of RDF (20:40:20:20::N: P₂O₅:K₂O:S kg/ha) was applied to all the plots as basal, through urea, DAP, MOP and phosphor.3gypsum. Soil was sandy loam in texture and acidic (pH-5.55) in reaction, with low to medium in soil fertility: organic carbon (4.3 g/kg), available nitrogen (169.07 kg/ha), available phosphorous (24.65 kg/ha), available potassium (148 kg/ha), available sulphur (9.76 mg/kg) and available boron (0.61 mg/kg). Crop was sown at spacing of 30 cm x 10 cm with the seed rate of 30 kg/ha on 14th July 2015-16 and 21st June 2016-17 and harvested on 22nd September 2016 and on 29 august 2017 respectively. Five plants in net plot area were randomly selected and tagged for observing plant height at 20, 40 and 60 days after sowing (DAS) and yield attributing characters were taken from the tagged plant and mean was recorded as average value plant of green gram. The five randomly selected plant from second rows were cut above the ground at 20,40,60 days after sowing (DAS) and at maturity for studying dry matter accumulation. The sample were first dried in sun then in an oven at 65 ± 5°C till reached constant weight. The dried weight was converted into g/m² for dry matter accumulation. Randomly selected plant from second row of the plot were taken for leaf area index at 20, 40, and 60 days after sowing (DAS) and it was calculated by dividing the leaf area per plant by land area occupied by plant given by Sestak et. al., (1971) [5].

$$LAI = \frac{\text{Leaf area per plant}}{\text{Land area occupied by plant}}$$

Randomly seeds were taken from the threshed cleaned produce of each net plot and exposed to sundry, 100 seeds were counted and weighted on electrical balance. The weight was expressed in gram(g).

Table-1 Effect of foliar application on plant height (pooled mean data of 2 years)

Treatments	40 DAS	60 DAS	AT HARVEST
T ₁ :RDF + Water spray	42.20	52.51	53.97
T ₂ :RDF + Urea @ 2% spray	54.49	68.17	69.26
T ₃ :RDF +TNAU Pulse Wonder @ 1% spray	50.18	58.08	59.74
T ₄ :RDF + Salicylic acid @ 75ppm spray	53.30	63.91	68.29
T ₅ : RDF + N:P:K(19:19:19) @ 2% spray	55.20	68.19	69.73
T ₆ :RDF + Urea @ 2% + Salicylic acid @ 75ppm spray	55.39	69.32	70.27
T ₇ :RDF + Boron @ 250ppm spray	42.60	58.54	59.69
T ₈ :RDF + Nitrobenzene @ 500ppm spray	50.58	63.04	64.57
T ₉ :RDF + DAP @ 2% spray	51.14	64.57	68.35
T ₁₀ :RDF + KCl @ 2% spray	52.74	63.28	64.97
SEm±	3.78	4.99	4.27
CD(P=0.05)	11.27	14.91	12.72

Table-2 Effect of foliar application on nodule number and number of branches (pooled mean data of 2 years)

Treatments	No. Of branches at 60 DAS
T ₁ : RDF + Water spray	6.25
T ₂ : RDF + Urea @ 2% spray	7.15
T ₃ : RDF +TNAU Pulse Wonder @ 1% spray	7.30
T ₄ : RDF + Salicylic acid @ 75ppm spray	7.14
T ₅ : RDF + N:P:K(19:19:19) @ 2% spray	7.32
T ₆ : RDF + Urea @ 2% + Salicylic acid @ 75ppm spray)	8.04
T ₇ : RDF + Boron @ 250ppm spray	6.67
T ₈ : RDF + Nitrobenzene @ 500ppm spray	7.25
T ₉ : RDF + DAP @ 2% spray	7.10
T ₁₀ : RDF + KCl @ 2% spray	7.20
SEm±	0.31
CD(P=0.05)	0.92

Table-3 Effect of foliar application on dry matter accumulation (pooled mean data of 2 years)

Treatments	40 DAS (g/m ²)	60 DAS (g/m ²)	At harvest (g/m ²)
T ₁ : RDF + Water spray	97.62	183.30	223.89
T ₂ : RDF + Urea @ 2% spray	99.33	227.51	288.98
T ₃ : RDF +TNAU Pulse Wonder @ 1% spray	97.86	194.62	241.79
T ₄ : RDF + Salicylic acid @ 75ppm spray	99.61	224.47	260.65
T ₅ : RDF + N:P:K(19:19:19) @ 2% spray	105.08	237.01	295.54
T ₆ : RDF + Urea @ 2% + Salicylic acid @ 75ppm spray	103.69	247.72	313.47
T ₇ : RDF + Boron @ 250ppm spray	100.15	194.61	235.17
T ₈ : RDF + Nitrobenzene @ 500ppm spray	101.57	202.13	239.70
T ₉ : RDF + DAP @ 2% spray	98.54	220.35	263.39
T ₁₀ : RDF + KCl @ 2% spray	97.87	211.38	265.38
SEm±	5.17	13.28	15.07
CD(P=0.05)	15.49	39.65	44.96

Table-4 Effect of foliar application on leaf area index (pooled mean data of 2 years)

Treatments	20 DAS	40 DAS	60 DAS
T ₁ :RDF + Water spray	0.38	1.47	3.06
T ₂ :RDF + Urea @ 2% spray	0.39	1.72	4.18
T ₃ :RDF +TNAU Pulse Wonder @ 1% spray	0.36	1.97	3.71
T ₄ :RDF + Salicylic acid @ 75ppm spray	0.40	1.67	3.95
T ₅ : RDF + N:P:K(19:19:19) @ 2% spray	0.36	1.69	4.27
T ₆ :RDF + Urea @ 2% + Salicylic acid @ 75ppm spray	0.40	1.54	4.50
T ₇ :RDF + Boron @ 250ppm spray	0.35	1.58	3.37
T ₈ :RDF + Nitrobenzene @ 500ppm spray	0.37	1.69	3.21
T ₉ :RDF + DAP @ 2% spray	0.36	1.80	3.97
T ₁₀ :RDF + KCl @ 2% spray	0.41	1.72	3.71
SEm±	0.04	0.18	0.18
CD(P=0.05)	0.12	0.52	0.66

Harvested pods from each net plot were threshed separately, winnowing, cleaned and dried in sun upto 14% moisture. The net plot grain yield was finally converted into kg/ha. The economic produce (such as grains) and by products (such as straw) obtained from each plot was calculated by multiplying the yield (both grain and straw) with the prevailing market prices have been computed and statistically analysed following analysis of variance method [6].

Results and Discussion

Growth parameters

Plant height increased with the different growth stages and highest values were obtained for the treatment having RDF (20:40:20:20 kg N:P₂O₅:K₂O:S /ha) along

with foliar application of Urea @ 2% + Salicylic acid @ 75ppm spray . At 40 DAS and 60 DAS, the plant height varied from 42.2 cm to 55.39 cm and 52.51 cm to 69.32 cm recorded in treatment T₆ (RDF + Urea @ 2% + Salicylic acid @ 75ppm spray) and was non-significant among the treatments. At harvest, the plant height varied from 53.97 cm 70.27 cm and significantly higher plant height (70.27 cm) was obtained with application of RDF + Urea @ 2% + Salicylic acid @ 75ppm spray (T₆) which was at par with all other treatments except application of RDF + Water spray(control) (T₁). This might be due to osmotic turgor of cell, increased in leaf area and total dry matter of mung bean. These finding are well supported by the work of Naidu *et al.*, (2015) [7], Khalilzadeh *et al.*, 2012 [8], Subhamoy Gupta *et al.* (2010) [9], Mondal *et al.*(2011) [10] and Verma *et al.* (2009) [11].

Table-5 Effect of foliar application on yield attributes of green gram (pooled mean data of 2 years)

Treatments	No. of pods/plant	No. of seeds/pods	100 seed weight (g)	Grain yield (kg ha ⁻¹)	Straw yield (kg ha ⁻¹)
T ₁ : RDF + Water spray	12.51	12.02	3.38	856.00	1367.00
T ₂ : RDF + Urea @ 2% spray	14.37	13.48	3.43	1044.00	1820.00
T ₃ : RDF +TNAU Pulse Wonder @ 1% spray	12.91	12.45	3.39	889.00	1525.00
T ₄ : RDF + Salicylic acid @ 75ppm spray	13.78	13.33	3.36	960.00	1647.00
T ₅ : RDF + N:P:K(19:19:19) @ 2% spray	14.88	13.92	3.46	1051.00	1860.00
T ₆ : RDF + Urea @ 2% + Salicylic acid @ 75ppm spray)	16.00	14.04	3.47	1099.00	2012.00
T ₇ : RDF + Boron @ 250ppm spray	12.85	12.82	3.43	889.00	1449.00
T ₈ : RDF + Nitrobenzene @ 500ppm spray	12.98	13.23	3.44	897.00	1406.00
T ₉ : RDF + DAP @ 2% spray	13.73	13.27	3.40	972.00	1652.00
T ₁₀ : RDF + KCl @ 2% spray	13.13	13.35	3.36	961.00	1595.00
SEm±	0.83	0.50	0.06	49.01	114.69
CD(P=0.05)	2.32	1.65	NS	145.99	342.35

Table-6 Effect of foliar application on economics of green gram (pooled mean data of 2 years)

Treatments	Cost of cultivation (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C ratio
T ₁ : RDF + Water spray	18772	42216	23444	1.25
T ₂ : RDF + Urea @ 2% spray	18840	51585	32745	1.74
T ₃ : RDF +TNAU Pulse Wonder @ 1% spray	19772	43871	24099	1.22
T ₄ : RDF + Salicylic acid @ 75ppm spray	19335	47372	28037	1.45
T ₅ : RDF + N:P:K(19:19:19) @ 2% spray	19192	51931	32738	1.71
T ₆ : RDF + Urea @ 2% + Salicylic acid @ 75ppm spray	18884	54292	35408	1.88
T ₇ : RDF + Boron @ 250ppm spray	18879	43866	24987	1.33
T ₈ : RDF + Nitrobenzene @ 500ppm spray	18817	44283	25466	1.35
T ₉ : RDF + DAP @ 2% spray	19785	47974	28188	1.43
T ₁₀ : RDF + KCl @ 2% spray	22872	47475	24603	1.08
SEm±	-	2437.00	2437.00	0.10
CD(P=0.05)	-	7307	7307	0.30

Number of branches per plant

Branching is an important character of crop, which bears the pods/ plant and ultimately enhanced the yield of crop. Number of branches per plant was varied from 6.25 to 8.04. The significantly maximum number of branches per plant (8.04) was produced with application of T₆. while application of TNAU Pulse Wonder @ 1% spray (7.30), RDF (20:40:20:20 kg N,P₂O₅,K₂O and sulphur /ha) + Nitrobenzene @ 500ppm spray (7.25), RDF (20:40:20:20 kg N, P₂O₅,K₂O and sulphur /ha) + KCl @ 2% spray (7.20), RDF (20:40:20:20 kg N, P₂O₅,K₂O and sulphur /ha) + Urea @ 2% spray (7.15), and RDF(20:40:20:20 kg N, P₂O₅,K₂O and sulphur /ha) + Salicylic acid @ 75ppm spray (T₄) (7.14). Minimum number of branches per plant (6.25) was recorded with RDF (20:40:20:20 kg N, P₂O₅,K₂O and sulphur /ha) + Water spray (control) (T₁). This might be due to continuous supply of nutrient through basal and foliar nutrient spray. These finding are well supported by the work of Verma *et al.* (2009) [11] and Gupta *et al.* (2011) [12].

Dry matter accumulation

Dry matter accumulation increased with the growth stages and highest values were obtained at different stages for the treatment. Application of recommended dose of fertilizer(RDF)at the rate of 20:40:20:20 kgN:P₂O₅,K₂O:S /ha along with foliar application of Urea @ 2% + Salicylic acid @ 75ppm spray recorded maximum dry matter accumulation in all the growth stages. At 40 DAS dry matter accumulation varied between 97.62 g/m² and 105.08 g/m² and was non-significant among the treatments. At 60 DAS, dry matter accumulation was varied from 183.30 to 247.72 g /m² and maximum dry matter accumulation (247.72 g/m²) was recorded in treatment RDF(20:40:20:20 kgN:P₂O₅,K₂O:S /ha) + Urea @ 2% + Salicylic acid @ 75ppm spray (T₆) which was at par with RDF + N:P:K(19:19:19) @ 2% spray (T₅) (237.01 g/m²). At harvest, dry matter accumulation was varied from 223.89g/m² to 313.47g/m².The significantly higher dry matter accumulation (313.47 g/m²) was obtained with application of Urea @ 2% + Salicylic acid @ 75ppm spray along with RDF(20:40:20:20 kgN:P₂O₅,K₂O:S /ha) (T₆), which was at par with RDF(20:40:20:20 kgN:P₂O₅,K₂O:S /ha) + N:P:K(19:19:19) @ 2% spray(T₅) (295.54 g/m²) and RDF(20:40:20:20 kgN:P₂O₅,K₂O:S /ha) + Urea @ 2% spray (T₂) (288.98 g/m²) and minimum (233.89g/m²) was obtained with RDF(20:40:20:20 kgN:P₂O₅,K₂O:S /ha) + Water spray(control) (T₁). These finding was well supported by the work of Naidu *et al.*, (2015) [7], Khalilzadeh *et al.*, 2012 [8], Subhamoy Gupta *et al.* (2010) [9] and Verma *et al.* (2009) [11].

Leaf area index

Leaf area index increased with the progress in plant growth and maximum value was obtained at 60 DAS. At 20 DAS and 40 DAS maximum leaf area index was recorded with RDF (20:40:20:20 kg N:P₂O₅,K₂O:S/ha) + KCl@ 2% spray was 0.41 (T₁₀) and with RDF(20:40:20:20 kg N:P₂O₅,K₂O:S/ha) + TNAU Pulse Wonder @ 1% spray was 1.97 (T₃) but was non-significant among the treatment. At 60 days after sowing(DAS), the leaf area index was varied from 3.06 to 4.50 and significantly maximum leaf area index (4.50) was produced with application of RDF(20:40:20:20 kg N:P₂O₅,K₂O:S/ha) + Urea @ 2% + Salicylic acid @ 75ppm spray (T₆) which was at par with RDF(20:40:20:20 kg N:P₂O₅,K₂O:S/ha) + N:P:K(19:19:19) @ 2% spray (T₅) recorded 4.27, RDF(20:40:20:20 kg N:P₂O₅,K₂O:S/ha) + Urea @ 2% spray (T₂) recorded 4.18, RDF(20:40:20:20 kg N:P₂O₅,K₂O:S/ha) + DAP @ 2% spray (T₉) recorded 3.97 and RDF(20:40:20:20 kg N:P₂O₅,K₂O:S/ha) + Salicylic acid @ 75ppm spray (T₄) recorded 3.95.while minimum leaf area index (3.06) was recorded with RDF(20:40:20:20 kg N:P₂O₅,K₂O:S/ha) + Water spray (control) (T₁). Treatments having RDF(20:40:20:20 kg N:P₂O₅,K₂O:S/ha) + Urea @ 2% + Salicylic acid @ 75ppm spray (T₆), RDF(20:40:20:20 kg N:P₂O₅,K₂O:S/ha)+N:P:K(19:19:19)@ 2% spray (T₅), RDF(20:40:20:20 kg N:P₂O₅,K₂O:S/ha)+ Urea @ 2% spray (T₂), RDF(20:40:20:20 kg N:P₂O₅,K₂O:S/ha)+DAP @ 2% spray (T₉) and RDF(20:40:20:20 kg N:P₂O₅,K₂O:S/ha) + Salicylic acid @ 75ppm spray (T₄) brought 47.05%, 39.52%, 36.6%, 31.91% and 29.08% increase in leaf area index at 60 DAS of green gram over control (20:40:20:20 kg N:P₂O₅,K₂O:S/ha) + Water spray) T₁. Higher leaf area index may be due to the foliar application of nitrogen enhancing the accumulation and translocation of nutrients which resulted in prolonged vegetative phase and better photosynthetic capacity of the plant. These finding were also supported by the work of Amutha *et al.* (2012) [13], Khalilzadeh *et al.*, 2012 [8], Mondal *et al.*, (2011) [10], Subhamoy Gupta *et al.* (2010) [9] Verma *et al.* (2009) [11] and Matwa *et al.*, 2017 [14].

Yield attributes

Number of pods/plant

Pod number is the major yield determinant in green gram crop. The number of pods per plant was varied from 12.51 to 16.00 .The maximum number of pods per plant (16.00) was observed with application of Urea @ 2% + Salicylic acid @ 75ppm spray (T₆) along with RDF(20:40:20:20 kg N:P₂O₅,K₂O:S/ha), which was at par with RDF(20:40:20:20 kg N:P₂O₅,K₂O:S/ha) + N:P:K(19:19:19) @ 2% spray

(T5) 14.88 pods per plant, RDF(20:40:20:20 kg N:P₂O₅:K₂O:S/ha) + Urea @ 2% spray (T2) 14.37 pods per plant and RDF(20:40:20:20 kg N:P₂O₅:K₂O:S/ha) + Salicylic acid @ 75ppm spray (T4) 13.78 pods per plant. The lowest number of pods per plant was recorded with application of RDF (20:40:20:20 kg N:P₂O₅:K₂O:S/ha) + Water spray (control) (T1) 12.51. Treatments with RDF(20:40:20:20 kg N:P₂O₅:K₂O:S/ha) + Urea @ 2% + Salicylic acid @ 75ppm spray (T6), RDF(20:40:20:20 kg N:P₂O₅:K₂O:S/ha) + N:P:K(19:19:19)@ 2% spray (T5), RDF(20:40:20:20 kg N:P₂O₅:K₂O:S/ha) + Urea @ 2% spray (T2) and RDF(20:40:20:20 kg N:P₂O₅:K₂O:S/ha) + Salicylic acid @ 75ppm spray (T4) produced 27.89%, 18.94%, 14.86% and 10.15% higher number of pods per plant than control (T1) respectively. The foliar application of nutrients through Urea 2% + Salicylic acid 75ppm spray might have reduced flower drop and this might have significantly increased the number of pods per plant. Similar finding was also reported by Mondal *et al.* (2011), Sritharan *et al.* (2007), Sritharan *et al.* (2005), Reddy *et al.* (2005) and Sujatha (2001).

Number of seeds/pods

Number of seeds per pod were significantly affected by foliar application of treatments and varied from 12.02 to 14.04. This finding was confirmed by the findings of Mondal *et al.* (2011) [10], Sritharan *et al.* (2007) [16], Reddy *et al.* (2005) [17] and Sujatha (2001) [18].

100 seed weight

100 seeds weight was varied from 3.36 g to 3.47 g and was non-significant among the treatments. Foliar application of salicylic acid recorded maximum 100 seed weight. The minimum 100 seed weight (3.36 g) was recorded with RDF(20:40:20:20 kg N:P₂O₅:K₂O:S/ha) + Salicylic acid @ 75ppm spray (T4) and RDF(20:40:20:20 kg N:P₂O₅:K₂O:S/ha) + KCl @ 2% spray (T10). This confirms the finding of Mondal *et al.* (2011) [11], Sritharan *et al.* (2007) [17], Sritharan *et al.* (2005) [15], Reddy *et al.* (2005) [17] and Sujatha (2001) [18].

Yield

Seed yield of green gram varied from 856 to 1099 kg/ha. Green gram crop fertilized with RDF(20:40:20:20 kg N:P₂O₅:K₂O:S/ha) along with Urea @ 2% + Salicylic acid @ 75ppm spray (T6) produced significantly highest grain yield (1099 kg/ha) and it was statistically at par with RDF(20:40:20:20 kg N:P₂O₅:K₂O:S/ha)+N:P:K(19:19:19) @ 2% spray (T5) (1051kg/ha), RDF(20:40:20:20 kg N:P₂O₅:K₂O:S/ha) + Urea @ 2% spray (T2) (1044kg/ha), RDF(20:40:20:20 kg N:P₂O₅:K₂O:S/ha) + DAP @ 2% spray (T9) (972kg/ha), RDF(20:40:20:20 kg N:P₂O₅:K₂O:S/ha) + KCl @ 2% spray (T10) (961kg/ha) and RDF(20:40:20:20 kg N:P₂O₅:K₂O:S/ha) + Salicylic acid @ 75ppm spray (T4) (960kg/ha) which recorded 1051 kg/ha, 1044kg/ha, 972kg/ha, 961 kg/ha and 960 kg/ha respectively. The minimum grain yield (856 kg/ha) of green gram was received with the application of RDF (20:40:20:20 kg N:P₂O₅:K₂O:S/ha) + Water spray (control) (T1). Treatment RDF(20:40:20:20 kg N:P₂O₅:K₂O:S/ha) along with Urea @ 2% + Salicylic acid @ 75ppm spray (T6) produced 28.38% higher grain yield than control(T1). Significantly higher grain yield might be due to the increased nutrient supply and reduced nutrient losses. It perhaps helped in quick absorption of nitrogen, at the time of reproductive stage where the nutrient demand is at the peak due to indeterminate growth habit of the crop. Hence it reduced the flower drop and ultimately enhanced the pod setting and resulted in higher seed yield. This result was also confirmed the findings of Jadhav and Kulkarni (2016) [19], Mondal *et al.*, (2012) [20], Mondal *et al.* (2011) [11], Malay and Bhowmick (2008) [21], Sritharan *et al.* (2007) [16], Sritharan *et al.* (2005) [15], and Sujatha (2001) [18]. The green gram straw yield was varied from 1367 to 2012 kg/ha. Green gram crop fertilized with RDF(20:40:20:20 kg N:P₂O₅:K₂O:S/ha) along with Urea @ 2% + Salicylic acid @ 75ppm spray (T6) produced highest straw yield (2012 kg/ha) and it was statistically at par with RDF(20:40:20:20 kg N:P₂O₅:K₂O:S/ha) + N:P:K(19:19:19) @ 2% spray (T5) and RDF(20:40:20:20 kg N:P₂O₅:K₂O:S/ha) + Urea @ 2% spray (T2) which recorded straw yield of 1860kg/ha, 1820 kg/ha respectively and minimum(1367kg/ha) was obtained with RDF(20:40:20:20 kg N:P₂O₅:K₂O:S/ha) + Water spray (control) (T1). The treatment having RDF(20:40:20:20 kg N:P₂O₅:K₂O:S/ha) along with

Urea @ 2% + Salicylic acid @ 75ppm spray (T6) produced 47.18% higher straw yield than control(20:40:20:20 kg N:P₂O₅:K₂O:S/ha + water spray). The increase in straw yield might be due to continuous supply of nutrients as basal and as nutrient spray which in turn increased the leaf area and dry matter accumulation resulting in higher straw yield. This confirms the finding of Mondal *et al.*, (2012) [20], Mondal *et al.* (2011) [10], Malay and Bhowmick (2008) [21], Sritharan *et al.* (2007) [16], Sritharan *et al.* (2005) [15] and Sujatha (2001) [18].

Economics

The pooled data on gross return, net return and benefit: cost ratio (Table- 6) was affected by foliar application of nutrient. Mean gross return was varied from Rs.42216 and Rs.54292 /ha with net return of Rs.2344 and Rs.35408 /ha and benefit: cost ratio 1.25 and 1.88. Green gram crop fertilized with RDF(20:40:20:20 kg N:P₂O₅:K₂O:S/ha) along with Urea @ 2% + Salicylic acid @ 75ppm spray (T6) produced significantly highest gross return (Rs.54292/ha) and it was statistically at par with RDF(20:40:20:20 kg N:P₂O₅:K₂O:S/ha) + N:P:K(19:19:19) @ 2% spray (Rs.51931/ha), RDF(20:40:20:20 kg N:P₂O₅:K₂O:S/ha)+Urea @ 2% spray (Rs.51585/ha), RDF(20:40:20:20 kg N:P₂O₅:K₂O:S/ha)+DAP @ 2% spray (Rs.47974/ha), RDF(20:40:20:20 kg N:P₂O₅:K₂O:S/ha)+KCl @ 2% spray (Rs.47475/ha) and RDF(20:40:20:20 kg N:P₂O₅:K₂O:S/ha) + Salicylic acid @ 75ppm spray (Rs.47373/ha), and lowest was obtained in RDF(20:40:20:20 kg N:P₂O₅:K₂O:S/ha) + Water spray control plot (Rs.42216/ha). The gross return of green gram was increased by 28.60% when crop was fertilized with RDF (20:40:20:20 kg N:P₂O₅:K₂O:S/ha) + Urea @ 2% + Salicylic acid @ 75ppm spray (T6) over RDF(20:40:20:20 kg N:P₂O₅:K₂O:S/ha) +Water spray (control). These finding are well supported by the work of Jadhav and Kulkarni (2016) [19], Shukla *et al.* (2013) [22], Yadav and Choudhary (2012) [23], Gupta *et al.*, (2011) [12], Deshmukh *et al.* (2008) [24] and Banasode *et al.* (2018) [25] for different leguminous crops.

Conclusion

On the basis of two year experimentation it was concluded that foliar application of Urea @ 2% + Salicylic acid @75ppm spray along with RDF (20:40:20:20 kg N:P₂O₅:K₂O:S/ha) produced higher grain yield as well as straw yield and economics of green gram which was more productive and economically viable for green gram cultivation for the farmers of Jharkhand.

Application of research: Study of green gram cultivation for the farmers of Jharkhand

Research Category: Crop Science

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Study area / Sample Collection: Birsa Agricultural University, Kanke, Ranchi

Cultivar / Variety name: Green gram - *Vigna radiata* L.

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