Maximizing the Productivity and Profitability of Summer Irrigated Greengram (*Vigna radiata* L.) by Combining Basal Nitrogen Dose and Foliar Nutrition of Nano and Normal Urea

ABSTRACT

Field experiment was conducted at wetland farm of Tamil Nadu Agricultural University, Coimbatore, during summer season, 2022 with an objective of maximizing the productivity and profitability of greengram by adopting varied dose of basal nitrogen and foliar application of nano and normal urea at Flower Initiation (FI) stage and 15 days thereafter. The experiment was laid out in factorial randomized block design and replicated thrice with the following treatments *viz*., N_1 - 100% RDN (25kg N ha^{-1}), N_2 -80% RDN(20kg N ha^{-1}),N_3 -60% RDN (15kg N ha^{-1}) and N_4 - Control as factor I, and F_1 - Nano urea @ 2ml $litre^{-1}$ of water, F_2 - Nano urea @ 3ml $litre^{-1}$ of water, F_3 - Nano urea @ 4ml $litre^{-1}$ of water andF_4 - 1% urea as factor II. The experiment results revealed that, 100% RDN and nano urea foliar spray @ 4ml $litre^{-1}$ of water significantly registered higher fertility co-efficient (71.2%), pods $plant^{-1}$ (38.5 Nos.), seeds pod^{-1} (12.7 Nos.) and maximum grain yield(1291 kg ha^{-1}). Nevertheless, it was on par with theapplication of 80% RDN and nano urea foliar spray @ 4ml $litre^{-1}$ of water, which recorded fertility co-efficient of 70.6%, 38.0 pods $plant^{-1}$, 12.6 seeds pod^{-1} and grain yield of 1289 kg ha^{-1}. In economics perspective also, application of100% RDN and foliar supplement of nano urea @ 4ml $litre^{-1}$ accounted maximum gross return (₹100114 ha^{-1}), net return (₹53549 ha^{-1}) and benefit-cost ratio (2.15), which was comparable with application of 80% RDN and foliar application of nano urea @ 4ml $litre^{-1}$ of water at FI stage and 15 days thereafter. Based on the experimental results, it is concluded that reduced application of basal nitrogen *i.e*., 80% RDN with nano urea foliar spray @ 4ml $litre^{-1}$ of water at FI stage and 15 days thereafter found to be the optimal nitrogen dose and nano urea foliar nutrition for maximizing the productivity and profitability of summer irrigated greengram.

Keywords: Summer irrigated greengram, basal nitrogen, foliar spray, nano urea, productivity and profitability

1. INTRODUCTION

Pulses are one among the gods gift to nature because they not only nourish themselves, instead they also nourish the environment where they grow. In the current trend of crop production under the intensive threat of climate variability and climate change, the concept of crop diversification and crop rotation plays an indispensable role in maintaining soil fertility and sustaining soil productivity [1]. Globally, majority of the crop diversification practices compulsorily include legumes as one of the component crop, as they are short duration in nature, requiring low amount of water for their growth and development, has the ability to fix atmospheric nitrogen, moderately resistant to biotic and abiotic stresses *etc.* Due to these inherent potentials, pulses are considered as an inevitable and integral crop in all the agricultural cropping systems and crop rotation practices both in intensive agriculture as well as in sustainable agriculture systems. Greengram/mungbean is one among those legumes, which is highly preferred by the farmers for cultivation as they come up well even in limited natural resources conditions and moderate crop management practices.In India, greengram is cultivated in an area of 5.13Mha and predominantly cultivated in Rajasthan, Madhya Pradesh and Maharashtra States. The total production and average productivity of greengram is 3.085MT and 601 kg ha^{-1} respectively [2]. Pulses in general contains higher amount of protein and greengram in specific contains 25% of protein, which makes it an unavoidable ingredient in the human diet. In general, basal application of nitrogen fertilizer significantly enhances the growth and development of the crops at their initial stages, whereas during the reproductive stages of the crop there won't be sufficient amount of nitrogen available to support the development and maturity of economic parts of the crop. Under these circumstances, supplemental application of nitrogen fertilizer on foliage of the crops at right stage, right source, right concentration of fertilizers and right methods of spray boosts up the yield attributes, enhances the photosynthetic process and its accumulation in economic parts of the crops and thereby maximizing the productivity of the crops. The main limiting factor for low productivity of greengram is severe flower dropping at peak flowering stage, which leads to poor pod setting percentage and these problems can be alleviated to some degree by supplying essential nutrients to the standing crop during their flower initiation and pod formation stages and this concept of foliar nutrition positively impacts the crop growth and development through many ways like increased efficiency of applied nutrients, overcoming nutrient deficiencies, instantaneous results after application, *etc.*[3]. In the current prospect, the concept of foliar feeding of nutrients and growth regulators is being practiced predominantly in all the agricultural and horticultural crop cultivation, as it helps in effective utilization of the nutrients which were supplied to the crop during their critical stages. So, in order to improve the nutrient use efficiencies of the applied nutrients to the crops, the right combination and levels of basal and foliar application of essential nutrients has to be evolved and adopted for sustainable crop production. Basal application of nutrients supports the crop during its early stages, whereas the foliar application of nutrients supports the crop during their critical stages thus ensuring higher flower retention rate, pod setting and seed setting percentage and thereby increasing the grain yield of crops. In recent times, Indian Farmers Fertilizer Cooperative Limited (IFFCO) had developed and released an innovative product named Nano Urea in liquid formulation in the Indian fertilizer market. This liquid nano urea, believed to supplement sufficient nitrogen to the crop, when it is applied as foliar spray at critical stages of crops. It is reported that, the use efficiency of nano urea is 80 per cent, which is almost 30-35 per cent superior to the foliar application of normal urea [4]. For the better crop growth and development as well as for realizing the potential yield of the greengram crop, there should be a comprehensive and integrated nutrient management practice, which must balance the nutrient availability to the crop at critical growth stages of the crop starting from grand vegetative stage to grain formation stage. Based on these facts, a field study was attempted to develop a right combination of basal nitrogen dose and foliar nutrition of nitrogen for summer irrigated greengram by factoring different basal dose of nitrogen and different concentrations of nano urea for foliar nutrition.

2. MATERIAL AND METHODS

Field experiment under summer irrigated condition was conducted for maximizing the productivity and profitability of greengramby combining basal nitrogen dose and foliar nutrition of nano and normal urea during summer season (March - May) of 2022 at wetland farm of Tamil Nadu Agricultural University, Coimbatore located at 11^{o} N latitude and 77^{o} E longitude and altitude of 426.7 m above mean sea level coming under the category of Southern agro-climatic zone of India and Western agro-climatic zone of Tamil Nadu State. During the cropping period, the average maximum and minimum temperature recorded were

34.5^{o} C and 23.6^{o} C respectively, and the mean morning and evening relative humidity were 82.7% and 45.6% respectively. A cumulative rainfall of 57.9 mm was received in 5 rainy days during the cropping period. The soil type of the experimental field is clay loam, which has a bulk density of 1.25 g cc^{-1}, pH of 8.19 (1:2 soil: water suspension solution), EC of 0.42 dSm^{-1} and organic carbon content of 0.66% (chromic acid wet digestion method). The availability of the primary nutrients *viz.*, nitrogen (alkaline permanganate method), phosphorus(Olsen method) and potassium(neutral normal ammonium acetate method)in the soil are 224.0 kg ha^{-1}, 16.4 kg ha^{-1} and 879.0 kg ha^{-1} respectively. This field experiment was laid out in Factorial Randomized Block Design (FRBD) involving two factors namely, varied dose of basal nitrogen as factor I and diverse concentrations of nano urea foliar spray and normal urea spray as factor II. The treatment details of factor I are: N_1 - 100% Recommended dose of nitrogen (RDN) (25kg N ha^{-1}), N_2 - 80% RDN (20kg N ha^{-1}), N_3 - 60% RDN (15kg N ha^{-1}) and N_4 - Absolute nitrogen control (0kg N ha^{-1}) and the treatment details of factor II are: F_1 - Nano urea @ 2ml litre^{-1} of water at Flower Initiation (FI) stage and 15 days thereafter, F_2 - Nano urea @ 3ml litre^{-1} of water at FI stage and 15 days thereafter, F_3 - Nano urea @ 4ml litre^{-1} of water at FI stage and 15 days thereafter, F_4 - 1% urea (normal fertilizer) at FI stage and 15 days thereafter. The combination of the factor I and II treatments (4*4 = 16 treatments) were replicated thrice. Besides the experimental treatments, recommended dose of phosphorus nutrient (50kg P_2O_5 ha^{-1}) was applied through single super phosphate fertilizer and potassium nutrient (25kg K_2O ha^{-1}) applied through muriate of potash fertilizer as basal nutrients in all the experimental plots, which has a gross plot and net plot measurement of 4.0 m x 4.0 m and 2.8 m x 3.6 m respectively. Greengram seeds of variety CO 8 was used in this field experiment and the chemically and biologically treated seeds were sown in lines by adopting the recommended row and plant spacing of 30 cm x 10 cm respectively with a seed rate of 20kg ha^{-1}. According to the treatment schedule, required quantity of urea was calculated and applied as a basal fertilizer for implementing factor I treatments, and for adopting foliar spray of nano urea and normal urea at flower initiation stage and 15 days thereafter in factor II, required quantity of nano urea as well as normal urea were measured and thoroughly mixed with required spray solution @ 500litres ha^{-1}. For better absorption of applied nutrients on the foliage of greengram, foliar application was executed during morning hours (before 10 AM) and evening hours (after 4 PM). The crop was irrigated five times during the cropping period. The data on yield attributes of greengram*viz.*, fertility co-efficient (%), number of pods plant^{-1} and number of seeds pod^{-1} and 100 seed weight (g) were calculated from5 randomly tagged plants in each experimental plot and average values were computed. Fertility co-efficient was calculated by using the formula proposed by [5].

$$\text{Fertility co-efficient} = \frac{\text{Number of pods plant}^{-1}}{\text{Number of flowers plant}^{-1}} \times 100$$

For assessing the grain yield and haulm yield, the border rows in each plot were harvested first and then the plants in the net plots were harvested separately. Seeds were separated through manual threshing and cleaning, thereafter the cleaned seeds were dried and the yield was recorded at 12 per cent moisture level and expressed in kg ha^{-1}. After threshing the matured pod, the haulm left in the net plot area were sun dried for three days and then dry weight of haulm of each treatment was computed and expressed in kg ha^{-1}. For calculating gross returns, net returns and benefit cost ratio, price of the greengram grain was adopted from the data released by the Ministry of Agriculture & Farmers Welfare, Government of India for fixing Minimum Support Price (MSP) for *kharif* crops, 2022. Significance of the difference observed in yield attributes, yield and economics of greengram under different basal nitrogen dose and various concentration of foliar nutrition of nano and normal urea were statistically analyzed by using AGRESS software, and compared using Analysis of Variance (ANOVA) and homogeneity test as suggested by [6]. Wherever the treatment differences were found statistically significant, the critical differences were worked out at 5 per cent probability level and the values were furnished.

3. RESULTS AND DISCUSSION

3.1. Yield attributes

Adoption of varied dose of basal nitrogen and diverse concentrations of nano urea and normal urea foliar spray significantly influenced the yield attributes *viz*., fertility co-efficient, number of pods plant^{-1} and number of seeds pod^{-1} of the greengram crop. Among the basal dose of nitrogen, the maximum fertility co-efficient (65.1 per cent), pods plant^{-1} (32.1 Nos.) and seeds pod^{-1} (11.3 Nos.) were recorded in basal application of 100% RDN, which was significantly higher than application of 60% RDN and absolute nitrogen control and was comparable with 80% RDN, which registered 63.9 per cent of fertility co-efficient,31.1 number of pods plant^{-1} and 11.0 number of seeds pod^{-1}. In general, increased supply of nitrogen increases the growth and enhance the physiological activities of the plant which in turn intensifies the formation of growth and yield attributing components. Increased nitrogen application is advantageous up to a certain level, above which the growth parameters and yield attributes diminishes. In the current study, it clearly indicates that application of 100% RDN as well as 80% RDN, significantly produced comparable yield attributes, which indicates the optimum dose of nitrogen requirement for better crop growth and development of yield attributes. The result of the experiment is on conformity with the results opined by [7,8].

Among the foliar nutrition studied, nano urea foliar spray @ 4ml litre^{-1} of water at flower initiation stage and 15 days thereafter significantly produced higher value of fertility co-efficient (64.4 per cent), pods plant^{-1} (31.2 Nos.), seeds pod^{-1} (11.2 Nos.), followed by nano urea foliar spray @ 3ml litre^{-1} of water at flower initiation stage and 15 days thereafter.The least fertility co-efficient of 51.8 per cent, pods plant^{-1} of 19.3 Nos., seeds pod^{-1} of 8.8 Nos. were noticed in 1% normal urea foliar spray at flower initiation stage and 15 days thereafter. The reason for superior performance of nano urea foliar spray @ 4ml litre^{-1} of water than the rest of the foliar sprays might be due to the fact that nano sized particles have massive surface area and they also possess smart delivery system *i.e*., controlled release pattern of nutrients which in turn increases the nutrient use efficiency of applied nutrients through foliar spray thereby providing sufficient nutrition to the crop at flower initiation and pod setting stages of the crop, thus positively tuned up the yield attributes *viz*., more flower retention rate, higher flower to pod conversion ratio and maximum seed formation rate of greengram. [9] also indicated that foliar spray of nano-based fertilizers significantly enhanced the use efficiency of applied fertilizers and thus maximized the yield components of the crops.

Considering the interaction effect between varied dose of basal nitrogen and diverse concentrations of nano urea and normal urea foliar spray at flower initiation stage and 15 days thereafter, combination of 100% RDN with nano urea foliar spray @ 4ml litre^{-1} of water at flower initiation stage and 15 days thereafter recorded significantly superior value of

Table 1. Influence of varied dose of basal nitrogen and diverse concentration of nano and normal urea foliar spray on yield attributes of greengram under summer irrigated conditions

Treatments	Fertility co-efficient (%)					No of pods plant $^{-1}$					Number of seeds pod $^{-1}$					100 seed weight (g)				
	F_1	F_2	F_3	F_4	Mean	F_1	F_2	F_3	F_4	Mean	F_1	F_2	F_3	F_4	Mean	F_1	F_2	F_3	F_4	Mean
N_1	65.7	69.9	71.2	53.5	**65.1**	31.2	37.6	38.5	20.9	**32.1**	11.0	12.2	12.7	9.1	**11.3**	3.33	3.38	3.41	3.28	**3.35**
N_2	64.9	68.2	70.6	51.8	**63.9**	30.3	36.0	38.0	20.0	**31.1**	10.5	12.0	12.6	8.9	**11.0**	3.30	3.35	3.40	3.26	**3.33**
N_3	55.2	64.4	64.9	51.5	**59.0**	23.6	29.8	30.6	19.5	**25.9**	10.3	10.4	10.6	8.8	**10.0**	3.28	3.30	3.32	3.25	**3.29**
N_4	50.5	50.6	50.9	50.2	**50.6**	17.1	17.6	17.8	16.6	**17.3**	8.5	8.6	8.7	8.3	**8.5**	3.22	3.23	3.25	3.20	**3.23**
Mean	**59.1**	**63.3**	**64.4**	**51.8**		**25.6**	**30.3**	**31.2**	**19.3**		**10.1**	**10.8**	**11.2**	**8.8**		**3.28**	**3.32**	**3.35**	**3.25**	
	N		F		N X F	N		N		N	N		N		N X F	N		F		N X F
SEd	1.9		1.9		3.8	1.0		1.0		2.0	0.4		0.4		0.7	0.11		0.11		0.22
CD (*P*=.*05*)	3.9		3.9		7.7	2.0		2.0		4.0	0.7		0.7		1.4	NS		NS		NS

Table 2. Effect of different dose of basal nitrogen and foliar nutrition of nano and normal urea on seed yield (kg ha $^{-1}$), haulm yield (kg ha $^{-1}$) and harvest index ofsummer irrigated greengram

Treatments	Seed yield (kg ha $^{-1}$)					Haulm yield (kg ha $^{-1}$)					Harvest index				
	F_1	F_2	F_3	F_4	Mean	F_1	F_2	F_3	F_4	Mean	F_1	F_2	F_3	F_4	Mean
N_1	1154	1250	1291	935	**1158**	2983	3260	3346	2502	**3023**	0.280	0.280	0.280	0.270	**0.278**
N_2	1125	1234	1289	916	**1141**	2818	3259	3334	2411	**2956**	0.290	0.270	0.280	0.277	**0.279**
N_3	969	1087	1145	841	**1010**	2614	2816	2868	2135	**2609**	0.270	0.280	0.290	0.283	**0.281**
N_4	718	743	768	686	**729**	1832	1884	1899	1777	**1848**	0.280	0.280	0.290	0.280	**0.283**
Mean	**991**	**1078**	**1123**	**844**		**2562**	**2805**	**2862**	**2206**		**0.280**	**0.278**	**0.285**	**0.278**	
	N		F		N X F	N		F		N X F	N		F		N X F
SEd	29		29		59	84		84		168	0.005		0.005		0.010
CD (*P*=.*05*)	60		60		120	171		171		NS	NS		NS		NS

Recommended dose of nitrogen

N_1 - 100% RDN (25 kg N ha $^{-1}$)

N_2 - 80% RDN (20 kg N ha $^{-1}$)

N_3 - 60% RDN (15 kg N ha $^{-1}$)

N_4 - Control

Foliar spray of nano urea

F_1 - Nano urea @ 2ml litre $^{-1}$ of water at flower initiation stage and 15 days thereafter

F_2 - Nano urea @ 3ml litre $^{-1}$ of water at flower initiation stage and 15 days thereafter

F_3 - Nano urea @ 4ml litre $^{-1}$ of water at flower initiation stage and 15 days thereafter

F_4 - 1% urea (Normal) at flower initiation stage and 15 days thereafter fertility co-efficient (71.2%), pods plant^{-1} (38.5 Nos.), seeds pod^{-1} (12.7 Nos.), which was on par with basal application of 80% RDN and nano urea foliar spray @ 4ml litre^{-1} of water at flower initiation stage and 15 days thereafter, which recorded the fertility co-efficient of 70.6 per cent, pods plant^{-1} of 38.0 Nos. and seeds pod^{-1} of 12.6 Nos. Higher pod setting percentage, production of more number of pods plant^{-1} and seeds pod^{-1} in greengram crop is due to basal application of higher dose of nitrogen fertilizer along with recommended dose of phosphorus and potassium, which supports the crop to good establishment and development up to the grand vegetative growth period, and subsequent application of foliar nutrition of nano urea at flowering initiation stage and 15 days thereafter, supplied nitrogen nutrient to the crop in a balanced way, which mitigate the nutritional deficiency of the primary nutrients at reproductive phase of the crop and thus it leads to attain maximum fertility co-efficient, higher number of pods plant^{-1} and seeds pod^{-1}. Similar findings were also reported in various crops like rice [10], wheat [11], maize [12,13] and finger millet [14]. The minimum fertility co-efficient (50.2 per cent), number of pods plant^{-1} (16.6 Nos.) and number of seeds pod^{-1} (8.3 Nos.) were recorded in the treatment combination of absolute nitrogen control and foliar supplement of 1% normal urea at flower initiation stage and 15 days thereafter.

100 seed weight of greengram was neither influenced by different dose of basal nitrogen nor by varied concentrations of nano urea foliar spray.

3.2. Yield

Perusal of the data presented in table 2 indicated that, application of varied dose of basal nitrogen and diverse concentrations of nano urea and normal urea spray significantly influenced the grain yield and haulm yield of greengram. Among varied dose of basal nitrogen, basal dose of 100% RDN produced more grain yield (1158 kg ha^{-1}) and haulm yield(3023 kg ha^{-1}) which was on par with 80% RDN, and are significantly higher than application of 60% RDN and absolute control. Application of adequate and optimum dose of nitrogen facilitates the greengram crop to grow to its fullest potential, which also improves the availability of nutrients, nutrient uptake and nutrient use efficiency throughout the cropping period which might have enhanced the translocation of photosynthates from source to sink and thereby enhanced the yield attributes and grain yield. The results of [15,16]also corroborate with the findings of the current study and indicates the importance of supply of adequate and optimum dose of nitrogen for maximizing the productivity of greengram.

In case of foliar nutrition, nano urea foliar spray @ 4ml litre^{-1} of water at flower initiation stage and 15 days thereafter recorded significantly higher grain (1123 kg ha^{-1}) and haulm yield (2862 kg ha^{-1}), which was closely followed by foliar supplement of nano urea @ 3ml litre^{-1} of water at flower initiation stage and 15 days thereafter yielding 1078 kg of grain ha^{-1} and 2805 kg of haulm ha^{-1}. The enhancement in grain and haulm yield is due to the intensification of yield attributing components. As pulse crops are highly prone to greater extent of flower drop, foliar supplement of nitrogen nutrition resolves the problem of flower shedding thus enhance the pod conversion ratio and seed setting per cent. Besides controlling flower drop, it also augments the source-sink relationship as nitrogen impart green color to the plants thereby extending the retention of photo-assimilatory surface until the crop attains its physiological maturity. The research findings of [17,18]also indicated similar results and reason for maximum yield in blackgram.

With regard to interaction effect between basal nitrogen and foliar spray of nitrogen nutrition, the treatment combination of 100% RDN with foliar application of nano urea @ 4ml litre^{-1} of water at flower initiation stage and 15 days thereafter registered maximum grain yield (1291 kg ha^{-1}) which was comparable with the combination of 80% RDN and foliar nutrition of nano urea @ 4ml litre^{-1} of water at flower initiation stage and 15 days thereafter (1289 kg ha^{-1}). The increase in seed yield in the treatment combination of 100% and 80% RDN with foliar application of nano urea @ 4ml litre^{-1} of water at flower initiation stage and 15 days thereafter was due to the superiority of yield attributing characters of this combination over other treatment combinations because of satisfactory application of nitrogen during initial stages of crop growth which effectively nourished the crop up to flowering stage, and at the time of flower initiation and pod setting, spraying of nano urea enhanced the production of yield attributing characters through their smart delivery nutrient supply system thus subsequently maximizing the uptake of nutrients and its use efficiency and accordingly contributing for maximizing the grain and haulm yield of greengram. The results obtained were similar to the findings of [19,20]in rice, [11] in wheat, [13] in maize and [14] in finger millet. Haulm yield was non-significant with respect to interaction.

Harvest index was not influenced by both the treatment factors *viz.*, basal nitrogen dose and foliar nutrition of nano urea.

3.3. Economics

Application of various dose of basal nitrogen as well as foliar spray of nano and normal urea at flower initiation stage and 15 days thereafter significantly enhanced the economics *viz.*, cost of cultivation, gross return, net return and benefit cost ratio. Among the levels of basal nitrogen and foliar spray, integrated supply of 100% RDN with foliar nutrition of nano urea @ 4ml litre^{-1} of water recorded maximum cost of cultivation (₹46565 ha^{-1}) followed by the combination of 80% RDN with foliar application of nano urea @ 4ml litre^{-1} of water (₹46500 ha^{-1}). With regard to profit earned also, treatment combination of basal supply of 100% RDN with nano urea foliar spray @ 4ml litre of water^{-1} at flower initiation stage and 15 days thereafter as well as the treatment combination of basal dose of 80% RDN integrated with foliar spray of nano urea @ 4ml litre^{-1} of water at flower initiation stage and 15 days thereafter accounted higher gross return of ₹100114 ha^{-1} and ₹99976 ha^{-1}, net return of ₹53549 ha^{-1} and ₹53475 ha^{-1} and recorded BC ratio of 2.15 each respectively. The higher economics of the summer irrigated greengram is due to the realization of maximum grain yield achieved by the adoption of comprehensive and integrated nitrogen management practices involving optimum level of basal nitrogen application and foliar nutrition of nano urea at peak reproductive stage of the crop. Similar kind of cost-effectiveness and economics was observed in maize [12] and in sweet corn [21] by the application of basal nitrogen and foliar supplement of nano-nutrients.

Table 3. Economics of greengram as influenced by various dose of basal nitrogen and foliar supplement of diverse concentration of nano and normal urea

Treatments	Cost of cultivation (₹)	Gross returns (₹)	Net returns (₹)	BC ratio
N_1F_1	45605	89493	43888	1.96
N_1F_2	46085	96938	50853	2.11
N_1F_3	46565	100114	53549	2.15
N_1F_4	43354	72509	29155	1.67
N_2F_1	45540	87244	41703	1.91
N_2F_2	46020	95697	49676	2.08
N_2F_3	46500	99976	53475	2.15
N_2F_4	43290	71036	27746	1.64
N_3F_1	43676	75122	31446	1.72
N_3F_2	45056	84297	39241	1.87
N_3F_3	45536	88795	43259	1.95
N_3F_4	42775	65220	22444	1.52
N_4F_1	43483	55658	12175	1.28

N_4F_2	43963	57591	13628	1.31
N_4F_3	44443	59553	15111	1.34
N_4F_4	42132	53199	11068	1.26

4. CONCLUSION

From the experiment, it was concluded that balanced application of basal nitrogen @ 100% or 80% RDN in combination with foliar nutrition of nano urea @ 4ml $litre^{-1}$ of water sprayed at flower initiation stage and 15 days thereafter found to be a viable option in terms of both productivity as well asprofitability of summer irrigated greengram. Since, both the treatment combinations produced higher yield attributes and yield which was on par with each other, the adoption of reduced dose of basal nitrogen *i.e*., 80% RDN integrated with foliar nutrition of nano urea @ 4ml $litre^{-1}$ of water at flower initiation stage and 15 days thereafter would be aneconomically viable optionfor maximizingas well as sustaining the productivity and profitability of greengram.

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