D-6115
[1-8]

RESEARCH ARTICLE

Agricultural Science Digest, Volume Issue : ()

Influence of Foliar Spray of Nutrients and PGR on Yield and Nutrient Uptake of Blackgram under Partial Shade in Coconut Garden

A.P. Pooja[1], M. Ameena[1], P. Arunjith[1]

10.18805/ag.D-6115

ABSTRACT

Background: Blackgram is one of the important pulse crop which suits well in intercropping system like coconut garden. As the yield of pulses in general is low, it is necessary to increase the yield using effective nutrient management strategies. Hence an attempt was made to study the influence of foliar spray of nutrients and plant growth regulators on productivity of blackgram intercropped in coconut garden.

Methods: An investigation was conducted at College of Agriculture, Vellayani, Kerala, India during *Rabi* 2020 and summer 2020-21 to understand the effect of foliar nutrition on yield and nutrient uptake of Blackgram under partial shade in coconut garden. The experiment was laid out in split plot design, replicated four times with five varieties (v_1 - Sumanjana, v_2 - D B G V 5, v_3 - V B N 5, v_4 - V B N 6, v_5 - C O 6) selected as the main plot treatments and six foliar sprays of nutrients and plant growth regulators as subplot treatments (f_1: 19:19:19 (1%) at 45 and 60 DAS, f_2: sulphate of potash SOP (0.5%) at 45 DAS and 15 days later, f_3: NAA 40 mg L^{-1} and salicylic acid 100 mg L^{-1} at pre-flowering (30-45 DAS) and 15 days later, f_4: f_3 + f_1, f_5: f_3 + f_2 and f_6: Control - KAU POP).

Result: The study identified *Sumanjana* and DBGV 5 as shade adaptive varieties with foliar spray of 19:19:19 (1%) at 45 and 60 DAS + foliar spray of NAA 40 mg L^{-1} and SA 100 mg L^{-1} at pre-flowering (35 DAS) and 15 days later with 21.84 per cent and 21.76 per cent yield increase respectively over existing package of practices recommendations with higher nutrient uptake and improved soil nutrient status.

Key words: Blackgram, Coconut garden, Foliar spray, Nutrient uptake, Yield.

INTRODUCTION

Blackgram [*Vigna mungo* (L.) Hepper], also known as urd bean, is a popular short-duration crop among pulses because it thrives in all seasons as a sole crop, intercrop, or catch crop and accounts for 13% of the country's total pulse area and 10% of its total pulse production (MoA and FW, 2021).

In the era of declining in land area and increasing population, inclusion of pulse crop in the cropping system is essential. The reduction on yield of blackgram may be due to increased flower drop and poor pod setting caused by floral abscission and lack of nutrients during key stage of crop growth (Mahala *et al.,* 2001). In addition to other climatic and agronomic constraints, a recent literature review by Swaminathan *et al.* (2021) summarized the varietal constraints causing low blackgram productivity and noted that foliar application of nutrients is an economical yet efficient method of fertilizer application. In order to increase blackgram productivity, they stressed the importance of choosing varieties that are appropriate for the circumstances as well as applying nutrients and/or growth regulators topically. Growth regulators and nutrition foliar spraying have a significant impact on the morphological traits, yield characteristics and yield in pulses (Sridhara *et al.,* 2022). There is a dearth of research on how foliar application of growth regulators and nutrients can increase the productivity of blackgram intercropped in coconut gardens.

[1]College of Agriculture, Agricultural University, Vellayani-695 522, Kerala, India.

Corresponding Author: Pooja, A.P., College of Agriculture, Agricultural University, Vellayani-695 522, Kerala, India.
Email: appoojaap@gmail.com

How to cite this article: Pooja, A.P., Ameena, M. and Arunjith, P. (2025). Influence of Foliar Spray of Nutrients and PGR on Yield and Nutrient Uptake of Blackgram under Partial Shade in Coconut Garden. Agricultural Science Digest. 1-8. doi: 10.18805/ag.D-6115.

Submitted: 07-07-2024 **Accepted:** 22-11-2024 **Online:** 20-02-2025

Plant growth regulators control plant growth and architecture to promote optimal vegetative development in shady or stressful environments. Additionally, they improve the interaction between sources and sinks and promote photo-assimilate translocation, which aids in the growth of fruit and seeds as well as efficient flower formation, eventually increasing agricultural yield and also will help to improve soil properties. In this backdrop, an investigation was conducted to study the effect of foliar nutrition and plant growth regulators on growth and yield of the identified shade tolerant Blackgram varieties under coconut garden.

MATERIALS AND METHODS

At the Instructional Farm of the College of Agriculture at Vellayani, Thiruvananthapuram, Kerala, the field trial was done during *Rabi* 2020 and summer 2020-21 in partially shaded coconut garden. The field is located 29 meters above mean sea level at latitude 8° 25' 46" N and longitude 76° 59' 24" E. The soil physicochemical properties are given in Table 1.

The experiment was laid out in split plot design, replicated four times with five varieties (v_1 - Sumanjana, v_2 - DBGV 5,v_3 - VBN 5,v_4 - VBN 6,v_5 - CO 6) which performed better in terms of yield per unit area under the partial shade in coconut garden (Pooja *et al.,* 2023) were selected as the main plot treatments and six foliar sprays of nutrients and plant growth regulators as subplot treatments (f_1: 19:19:19 (1%) at 45 and 60 DAS, f_2: SOP (0.5%) at 45 and 60 DAS, f_3: NAA 40 mg L^{-1} and salicylic acid 100 mg L^{-1} at pre-flowering (30-45 DAS) and 15 days later, f_4: f_3 + f_1, f_5: f_3 + f_2 and f_6: Control - KAU POP).

Over-40-year-old coconut gardens with light intensities between 40 and 46.5 klux were chosen, with beds measuring 6 m in length and 3 m in width being taken as the main plots in the spaces between the coconut palms. A two-meter radius was left around the base of each coconut palm. Subplots of 3 m × 1 m were then created by dividing the main plot.

Blackgram seeds were added to a Rhizobium culture containing the strain BMBS 47 and sown at a spacing of 25 cm × 15 cm. Urea, rajphos and muriate of potash were used to supply the nutrients (20:30:30 kg N: P_2O_5: K_2O ha^{-1}) (KAU, 2016). Along with full dosages of P and K, the remaining half of the N dosage was applied as two foliar sprays at 15 and 30 days after sowing (DAS). Weeding was done twice, at 15 and 30 DAS. According to the prescribed treatments, foliar spraying of nutrients and plant growth regulators was carried out.

Three pickings were made once the varieties and cultures matured in 80-100 days, depending on the varietal characteristics. The yield was recorded from the net plot area and expressed in kg ha^{-1}. Soil samples were analysed both before and after the experiments to determine changes in pH, electrical conductivity, organic carbon and available NPK. Plant samples were analysed for NPK content and was multiplied by their total dry matter production and the result was given in kg ha^{-1}. Statistical analysis was done.

RESULTS AND DISCUSSION

Yield of blackgram as influenced by foliar spray of nutrients and plant growth regulators

Significant variation in seed yield ha^{-1} was observed during summer and *rabi* (Table 2). Varieties tested were found to vary significantly with respect to seed yield ha^{-1}. Among these, Sumanjana recorded higher per hectare seed yield and was on par with DBGV 5 during both the seasons (1530 kg ha^{-1} and 1501 kg ha^{-1} in summer and 1447 kg ha^{-1} and 1446 kg ha^{-1} in *Rabi* respectively). There was significant difference in seed yield ha^{-1} due to foliar spray during both the seasons. Foliar application of 19:19:19 (1%) at 45 and 60 DAS + NAA 40 mg L^{-1} and SA 100 mg L^{-1} at pre-flowering and 15 days later (f_4) recorded the highest seed yield in both the seasons (1536 kg ha^{-1} and 1474 kg ha^{-1}). It was deduced that application of NAA negated flower drop which was manifested as increased seed yield in these two shade adaptive varieties. Salicylic acid foliar spray can improve sink strength by promoting cell division in developing ovaries and it also transports metabolites to growing grains to lower the risk of abortion (Horvath *et al.*, 2007). Increased seed yield of pulse with foliar application of nutrients could be attributed to reduced flower drop and increased pod set percentage (Mamathashree, 2014).

Main and subplot effects were reflected in the interaction and higher seed yield ha^{-1} was recorded in Sumanjana (v_1) with sub plot treatment f_4 and was on par with DBGV 5 (v_2) with f_4 in the summer season (1750 kg ha^{-1} and 1713 kg ha^{-1}). During *Rabi*, the highest seed yield was recorded in v1f4 (1700 kg ha^{-1}). Foliar nutrients often enter the cells through the stomata or cuticle of the leaf, making it easier for nutrients to enter. According to Manonmani and Srimathi (2009), foliar spray is attributed with extremely quick absorption and almost full usage of nutrients, elimination of leaching losses and fixing and aid in controlling the

Table 1: Physico-chemical properties of the soil in the experimental field.

Characteristics	Content (%)	Method
Mechanical composition	16.70	International pipette method
Coarse sand Fine sand	30.38	(Piper, 1966)
Silt	25.50	
Clay	26.50	
Textural class		**Sandy clay loam**
Particular	Value	Reference
Soil reaction (pH)	5.9 (Moderately acidic)	pH meter with glass electrode (Jackson, 1973)
Electrical conductivity (dS m^{-1})	0.145(Safe)	Digital conductivity meter (Jackson, 1973)
Organic carbon (%)	0.93(high)	Walkley and Black Rapid Titration method (Jackson,1973)
Available N (kg ha^{-1})	191.30(low)	Alkaline permanganate method (Subbiah and Asija, 1956)
Available P (kg ha^{-1}	33.21(high)	Bray colorimetric method (Jackson, 1973)
Available K (kg ha^{-1})	345.24(high)	Neutral normal ammonium acetate using flame photometer method (Jackson, 1973)

uptake of nutrients by plants. This may be ascribed to the crop's demand being provided by greater phosynthate absorption and translocation from source (leaves) to sink (pods) through the provision of necessary nutrients by 19:19:19 foliar spray. These results are in corroboration with the findings of Kuttimani and Velayutham (2011).

With seed yields of 1489 kg ha^{-1} and 1473 kg ha^{-1}, respectively, Sumanjana and DBGV 5 were found to perform better under restricted shade in a pooled examination of seed production. With 1505 kg ha^{-1}, the subplot factor f4 recorded the highest seed output. The largest seed yield was obtained by v1f4 (1725 kg ha^{-1}) and v2f4 (1626 kg ha^{-1}). This combination of main and subplot variables is thought to be the result of the above-explained positive interaction of individual effects (Fig 1). On comparison with KAU Package, Sumanjana and DBGV 5 under foliar spray of nutrients and PGR evinced 21.84 and 21.76 per cent increase in seed yield over v1f6 and v2f6 respectively (Fig 2). Higher LAI and chlorophyll concentrations in v_1f_6 and v_2f_6 may have enhanced photosynthetic activity, resulting in increased carbohydrate synthesis and assimilate translocation from source to sink, both of which ultimately helped to increase seed output. Also, higher number of nodules and nodule mass might have enhanced the assimilation, production of proteins and translocation of carbohydrate from source to sink which might have led to higher seed yield ha^{-1}. Better crop growth enhanced the absorption of nutrients through root and enhanced the synthesis of IAA, carbohydrate and N metabolism which ultimately led to higher economic yield. The fact that plants treated with macronutrients and growth regulators continued to be physiologically more active to accumulate adequate food reserves for the developing flowers and seeds may be the cause of the greater seed output produced as a result of the nutrients and growth regulators.

Table 2: Effect of varieties and foliar application on seed yield during summer 2020, *Rabi* 2020-21 and pooled seed yield, kg ha^{-1}.

Treatments	Seed yield (kg ha^{-1})		Pooled mean seed yield (kg ha^{-1})
	Summer 2020	*Rabi* 2020-21	
Main plot - Varieties (V)			
V_1 – Sumanjana	1530	1447	1489
V_2 - DBGV 5	1501	1446	1473
V_3 - VBN 5	1259	1230	1244
V_4 - VBN 6	1203	1176	1189
V_5 - CO 6	1367	1314	1341
SEm (±)	13.80	22.30	12.90
LSD (0.05)	42.44	68.76	37.29
Sub plot - Foliar spray (F)			
F_1 - Foliar spray of 19:19:19 @ 1%	1319	1279.77	1299
F_2 - Foliar spray of SOP @ 0.5%	1288	1246.81	1267
F_3 - NAA 40 mg L^{-1} and SA 100 mg L^{-1}	1419	1365.95	1392
F_4 - F_3 + F_1	1536	1473.51	1505
F_5 - F_3 + F_2	1439	1387.43	1413
F_6 - Control (KAU POP)	1230	1181.88	1206
SEm (±)	18.80	18.36	41.30
LSD (0.05)	52.96	51.73	116.24

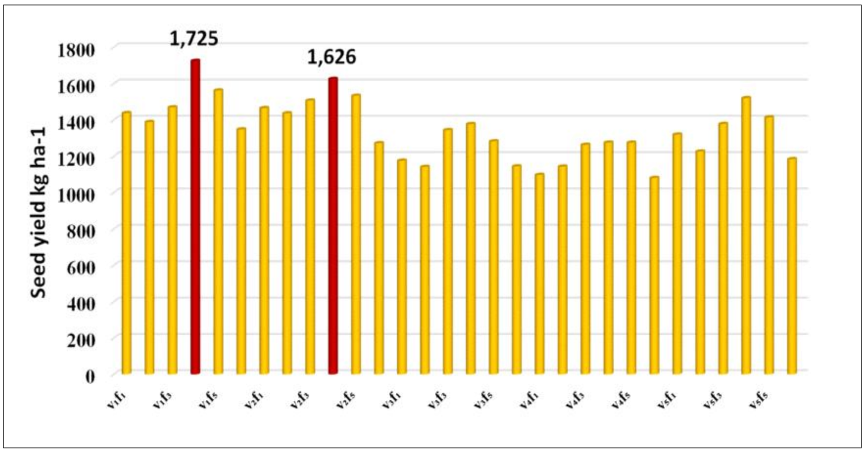

Fig 1: Interaction effect of varieties and foliar spray of nutrients and plant growth regulator on pooled seed yield.

NPK uptake of blackgram

The data on the effect of varieties, foliar spray and their interaction on NPK uptake of Blackgram during the both the seasons are given in Table 3a and 3b. There was significant variation in NPK uptake due to treatments.

Crop nutrient uptake is correlated with plant nutrient content and dry matter production, which in turn is correlated with plant photosynthetic capacity. During both the seasons, comparatively higher NPK uptake was observed in the varieties Sumanjana and DBGV 5. This might be attributed to higher content of N, P, K and increased morphological attributes and LAI which resulted in higher dry matter production in the respective varieties. Increased N, P and K levels in plants may be attributed to water soluble fertilizers with greater concentrations that plants have directly absorbed through leaves. The findings of Tohamy *et al.* (2011) and the results are in accord.

Regarding the subplot factor f_4 recorded higher NPK uptake and was on par with f_3 and f_5 in summer season and the highest NPK uptake was recorded in f_4 during *Rabi*. Nutrients and PGRs given via foliage aided with improved nutrient uptake and effective photoassimilates translocation to all regions of the plant, which in turn led to enhanced activity of functional root nodules and increased dry matter production. More flower production, followed by pod development and other yield-attributing traits, may have

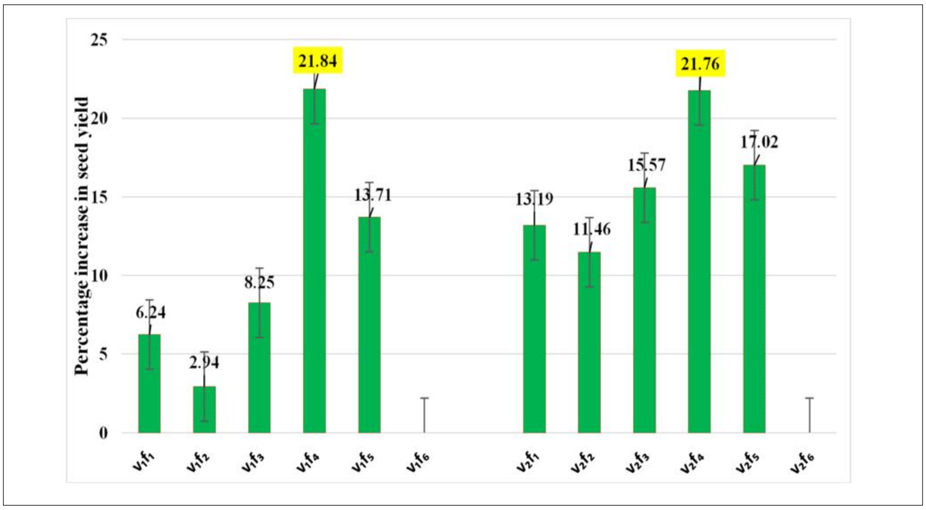

Fig 2: Percentage increase in seed yield of Sumanjana and DBGV 5 against its corresponding control as influenced by foliar application.

Table 3a: Effect of varieties and foliar application on N, P and K uptake (kg ha^{-1}) during summer 2020 and *rabi* 2020-21.

Treatments	Summer 2020			*Rabi* 2020-21		
	N uptake	P uptake	K uptake	N uptake	P uptake	K uptake
Main plot - Varieties (V)						
V_1 – Sumanjana	129.27	18.89	135.05	128.28	17.69	135.10
V_2 - DBGV 5	132.70	15.84	139.38	122.80	15.35	127.46
V_3 - VBN 5	108.45	13.71	112.87	107.46	13.60	111.15
V_4 - VBN 6	99.50	11.29	102.68	96.35	11.01	100.81
V_5 - CO 6	115.02	15.12	119.83	107.94	14.45	113.68
SEm (±)	1.37	1.33	1.59	1.20	0.23	1.15
LSD (0.05)	4.212	0.433	4.742	3.698	0.718	3.550
Sub plot - Foliar spray (F)						
F_1 - Foliar spray of 19:19:19 @ 1%	113.53	14.12	118.58	109.44	14.04	116.32
F_2 - Foliar spray of SOP @ 0.5%	111.16	14.00	116.43	107.92	13.8	111.66
F_3 - NAA 40 mg L^{-1} and SA 100 mg L^{-1}	119.85	15.57	125.64	115.69	14.23	118.48
F_4 - $F_3 + F_1$	124.13	16.31	129.75	123.43	16.75	126.97
F_5 - $F_3 + F_2$	122.96	15.91	127.47	115.00	15.08	122.57
F_6 - Control (KAU POP)	110.31	13.91	113.91	103.92	12.62	109.83
SEm (±)	2.68	0.48	2.42	1.51	0.16	1.38
LSD (0.05)	7.564	1.346	6.807	4.260	0.436	3.881

Note: F_1, F_2 - 45 and 60 DAS; F_3- Pre flowering (30-35 DAS) and 15 days later.

resulted from this. Fritz (1978) shown that tiny amounts of foliar fertilizers applied during crucial plant growth phases boosted nutrient absorption and promoted plant metabolism.

During *Rabi,* v1f4 recorded the highest NPK uptake due to the higher yield and dry matter accumulation. According to Tabassum *et al.* (2013), increasing nutritional availability accelerate physiological processes, which in turn affect the formation of dry matter and nutrient absorption. The absorption of N and K was much greater, which may have contributed to the higher yield. According to Sangwan and Raj (2004) report on chickpea and Anitha *et al.* (2005) research on cowpea, the results are consistent. Amjad *et al.* (2004) and Calhor (2006) showed increased photosynthetic efficiency, assimilation and dry matter production as a result of enhanced nutrient availability and absorption.

Soil properties

Perusal of the data revealed that the varieties, foliar spray and their interaction did not exert any substantial influence on soil pH and electrical conductivity during both the seasons (Table 4). Nevertheless an increase in the soil pH status from initial value (5.9) was recorded with the cultivation of different Blackgram varieties with foliar spray during both the seasons. This could be attributed to the effect of liming done before sowing. Liming can raise the soil pH (Goulding, 2016) as a result of desorption of the Al3+ and H+ ions from the exchange sites to soil solution.

There was no significant variation in organic carbon solely due to varieties and foliar spray and their interaction in the summer season. During the *Rabi* season, the plots grown with the varieties, Sumanjana and DBGV 5

Table 3b: Interaction effect of varieties and foliar application on N, P and K uptake (kg ha^{-1}) of blackgram during summer 2020 and *Rabi* 2020-21.

Treatments	Summer 2020			*Rabi* 2020-21		
	N uptake	P uptake	K uptake	N uptake	P uptake	K uptake
V_1F_1	139.31	19.87	145.77	130.81	18.98	135.74
V_1F_2	121.00	19.06	126.94	118.63	18.10	124.98
V_1F_3	130.59	18.92	137.15	124.44	14.75	126.96
V_1F_4	131.23	18.09	134.45	148.83	22.68	157.59
V_1F_5	131.94	19.37	138.46	122.80	17.01	133.65
V_1F_6	121.53	18.05	127.53	124.18	14.59	131.65
V_2F_1	126.83	14.22	134.09	122.81	15.53	131.84
V_2F_2	136.80	15.96	144.65	127.50	16.54	129.88
V_2F_3	130.04	16.36	136.77	119.35	14.86	124.57
V_2F_4	141.44	17.14	148.56	128.12	15.14	127.01
V_2F_5	132.29	15.96	138.33	122.71	15.29	128.54
V_2F_6	128.83	15.38	133.86	116.30	14.77	122.90
V_3F_1	106.48	12.74	108.29	105.09	12.90	112.73
V_3F_2	100.25	12.38	105.51	99.71	11.92	114.21
V_3F_3	114.06	14.76	119.81	115.64	14.44	114.62
V_3F_4	120.70	16.30	126.75	120.28	16.62	118.97
V_3F_5	114.18	14.65	117.71	104.45	14.59	116.74
V_3F_6	95.00	11.40	99.14	99.61	11.10	99.61
V_4F_1	87.32	10.01	91.65	89.25	9.66	88.63
V_4F_2	92.84	9.79	94.95	91.44	9.46	93.87
V_4F_3	111.10	11.97	115.41	97.81	11.25	110.54
V_4F_4	100.53	12.70	105.86	104.82	12.71	102.51
V_4F_5	111.26	12.98	116.87	108.64	13.04	115.30
V_4F_6	93.97	10.30	91.36	86.15	9.91	94.03
V_5F_1	107.70	13.74	113.09	99.24	13.12	112.64
V_5F_2	104.92	12.82	110.10	102.33	12.96	105.37
V_5F_3	113.45	15.81	119.05	121.20	15.84	115.71
V_5F_4	126.75	17.32	133.10	115.10	16.60	128.79
V_5F_5	125.11	16.60	125.98	116.40	15.46	118.60
V_5F_6	112.20	14.44	117.67	93.37	12.72	100.95
SEm (±)	5.65	1.07	5.17	3.31	0.39	3.04
LSD (0.05)	NS	NS	NS	9.45	1.14	8.68

showed higher organic carbon contents. Wani *et al.* (2003) and Jensen *et al.* (2012), found that the addition of legumes to the rotation greatly increased the soil's organic carbon content and nutritional availability. There was significant variation in organic carbon due to foliar spray in *Rabi* and the treatment f_4 recorded highest organic carbon. The enhancement in organic carbon content observed in all the treatments might be due to the decomposition of farmyard manure (20 t ha^{-1}) coupled with the left over residues of the previous crop after summer. According to Lynch and Whips (1990), root exudates made up roughly 40% of the dry matter the plant accumulated and was discharged into the rhizosphere. Hasanuzzaman *et al.* (2019), reported that the release of organic compounds (organic acids, amino acids, sugars, vitamins, mucilage, *etc.*) into the rhizosphere during crop growth as well as owing to the addition of organic matter in the form of FYM may have increased the soil's organic carbon content. Bochalya *et al.* (2021) reported improved organic carbon status due to the foliar spray of 19:19:19 at flowering stage in wheat. The treatment combinations v_1f_4, v_2f_4 and v_5f_4 recorded higher organic carbon content and were on par with v_2f_5. Organic carbon was observed to have increased from the initial status (0.93) after the harvest of

Table 4: Effect of varieties and foliar application on soil pH, EC and organic carbon content during summer 2020 and *rabi* 2020-21.

Treatments	Summer 2020			*Rabi* 2020-21		
	Soil pH	EC ($ds\ m^{-1}$)	Organic carbon (%)	Soil pH	EC ($ds\ m^{-1}$)	Organic carbon (%)
Main plot - Varieties (V)						
V_1 - Sumanjana	6.28	0.168	0.98	5.98	0.155	0.96
V_2 - DBGV 5	6.23	0.170	0.95	5.78	0.150	0.95
V_3 - VBN 5	6.21	0.167	0.93	5.67	0.150	0.78
V_4 - VBN 6	6.23	0.168	0.96	5.73	0.150	0.79
V_5 - CO 6	6.22	0.175	0.96	5.74	0.152	0.94
SEm (±)	0.06	0.002	0.02	0.09	0.001	0.03
LSD (0.05)	NS	NS	NS	NS	NS	0.011
Sub plot - Foliar spray (F)						
F_1 - Foliar spray of 19:19:19 @ 1%	6.22	0.171	0.96	5.71	0.149	0.89
F_2 - Foliar spray of SOP @ 0.5%	6.22	0.171	0.93	5.77	0.153	0.89
F_3 - NAA 40 mg L^{-1} and SA 100 mg L^{-1}	6.24	0.169	0.97	5.73	0.151	0.84
F_4 - $F_3 + F_1$	6.25	0.165	0.95	6.04	0.157	1.04
F_5 - $F_3 + F_2$	6.22	0.169	0.96	5.69	0.150	0.93
F_6 - Control (KAU POP)	6.25	0.175	0.97	5.74	0.150	0.71
SEm (±)	0.017	0.003	0.01	0.08	0.002	0.01
LSD (0.05)	NS	NS	NS	0.23	NS	0.03

Table 5: Effect of varieties and foliar application on available N, P and K status of the soil during summer 2020 and *Rabi* 2020-21, kg ha^{-1}.

Treatments	Summer 2020			*Rabi* 2020-21		
	Available N	Available P	Available K	Available N	Available P	Available K
Main plot - Varieties (V)						
V_1 - Sumanjana	188.16	37.06	376.90	209.42	40.08	366.97
V_2 - DBGV 5	184.50	36.26	370.41	206.32	38.68	360.38
V_3 - VBN 5	175.62	35.67	362.34	170.57	37.98	356.13
V_4 - VBN 6	175.62	36.55	371.27	171.94	38.38	357.63
V_5 - CO 6	171.43	36.40	367.23	201.78	38.45	358.05
SEm (±)	0.24	0.49	4.36	1.99	0.60	5.03
LSD (0.05)	0.72	NS	NS	6.14	NS	NS
Sub plot - Foliar spray (F)						
F_1 - Foliar spray of 19:19:19 @ 1%	191.30	36.41	369.81	194.31	38.25	356.43
F_2 - Foliar spray of SOP @ 0.5%	163.07	35.42	360.07	195.19	38.64	361.43
F_3 - NAA 40 mg L^{-1} and SA 100 mg L^{-1}	165.58	36.98	375.59	182.20	38.42	358.93
F_4 - $F_3 + F_1$	208.23	35.91	364.70	223.25	40.41	368.74
F_5 - $F_3 + F_2$	175.62	36.66	372.32	202.28	38.08	356.13
F_6 - Control (KAU POP)	170.60	36.95	375.28	154.80	38.47	357.33
SEm (±)	0.26	0.46	4.45	2.67	0.52	5.16
LSD (0.05)	0.72	NS	NS	7.52	1.48	NS

Blackgram. There was significant improvement in the organic carbon status in the *Rabi* compared to the summer season. The probable reason of higher organic carbon in the *Rabi* might be due to the residue decomposition of summer crop in the next *Kharif* season and also due to the addition of organic manures to the *Rabi* crop.

There was an improvement in the N, P and K status compared to the initial status (Table 5). Legumes in rotation boosted the NPK content of soil (Thamburaj, 1991). The crop was able to get nutrients from the deeper strata thanks to enhanced crop establishment and roots. The availability of N was shown to be higher in treatments with higher levels of organic carbon, which may be the result of symbiotic N-fixing bacteria in the nodule fixing ambient N. The outcome is consistent with Sakin's (2012) findings, who claimed that high soil organic carbon improved the soil's N content. After the trial, it was discovered that all of the treatments had significant levels of available P in the soil. Increased soil organic carbon content maintained soil fertility by preventing nutrient leakage. Similar observation was also made by Suman (2018).

The varieties Sumanjana and DBGV 5 recorded higher available N compared to other varieties which might be due to comparatively higher root nodulation, which is expected to have contributed more N in soil. In the case of subplot factor, f_4 recorded higher N during both the seasons and the highest P status in *Rabi* season. This can be correlated with the higher nodules number and dry weight of nodules per plant observed in f_4 which might have contributed more biological N fixation and rhizo-deposition.

This will mobilize the fixed P in the soil and make it in the available form. The interaction effect was a reflection of main and subplot effects and the treatment combination v_1f_4 and v_2f_4 recorded comparatively higher N status after the experiment during both the seasons. Even though, the uptake of N was higher in Sumanjana and DBGV 5, the greater contribution of N by fixation recorded increment in soil available N status. Exploration of the effect of legumes on soil enrichment have shown that nitrogen fixation and rhizodeposition of N from legumes increased the available N status in soil (Zhang *et al.,* 2015).

CONCLUSION

The varieties performed differently under partial shade and responded to nutrient application in varied manner. Sumanjana or DBGV 5 raised under partial shade in coconut garden with recommended dose of nutrients supplemented with foliar application of 19:19:19 (1%) at 45 and 60 DAS + NAA 40 mg L^{-1} and SA 100 mg L^{-1} at pre-flowering and 15 days later (f_4) realized higher yield, nutrient uptake and improved soil nutrient status.

Conflict of interest

All authors declared that there is no conflict of interest.

REFERENCES

Amjad, M., Anjum., M. A. and Akhtar, N. (2004). Influence of phosphorus and potassium supply to the mother plant on seed yield, quality and vigour in pea (*Pisum sativum* L.). Asian Journal of Plant Science. 3(1): 108-113.

Anitha, S., Sreenivasan, E. and Purushothaman, S. M. (2005). Response of cowpea (*Vigna unguiculata* (L.) Walp) to foliar nutrition of zinc and iron in the oxisols of Kerala. Legume Research. 28(4): 294-296.

Bochalya, R.S., Gupta, A.K., Sharma, B.C., Puniya, R., Thakur, N.P. and Singh, M.S.P. (2021). Residual effect of biofertilizer consortium and foliar nutrition on soil chemical properties after harvest of blackgram crop as affected by different fertility levels under subtropical condition of Jammu. Pharma Innovations Journal. 10(7): 605-608.

Calhor, M. (2006). Effect of nitrogen and zinc on yield of durum wheat in khorramabad region. International Journal of Agriculture Crop Science. 5: 1-5.

Fritz, A. (1978). Foliar fertilization-a technique for improved crop production. Africa Symposium on Horticulture Crops Acta Horticulture. 84: 150-161.

Goulding, K.W.T. (2016). Soil acidification and the importance of liming agricultural soils with particular reference to the United Kingdom. Soil Use Management 32(3): 390-399.

Hasanuzzaman, M., Masud, A.C., Bhuiyan, T.F. and Anee, T.I. (2019). Legumes for soil fertility management and sustainable agriculture. SATSA Mukhapatra-Annual Technical.s (23): 29-46.

Horvath, E., Sazalai, G., Janda, T. (2007). Induction of abiotic stress tolerance by salicylic acid signaling. Journal of Plant Growth Regulators. 26: 290-300.

Jensen, E.S., Peoples, M.B., Boddey, R.M., Gresshoff, P.M., Hauggaard-Nielsen, H., Alves, B.J. and Morrison, M.J. (2012). Legumes for mitigation of climate change and the provision of feedstock for biofuels and biorefineries: A review. Agronomy for Sustainable Development. 32(2): 329-364.

KAU [Kerala Agricultural University]. (2016). Package of Practices Recommendations: Crops (15th Ed.). Kerala Agricultural University, Thrissur. 393p.

Kuttimani, R. and Velayutham, A. (2011). Foliar application of nutrients enhances the yield attributes and nutrient uptake of greengram. Agricultural Science Digest. 31(3): 202-205.

Lynch, J.M. and Whips, J.M. (1990). Substrate flow in the rhizosphere. Plant Soil. 129: 1-10.

Mahala, C., Dadheech, R. and Kulhari, R. (2001). Effect of plant growth regulators on growth and yield of Blackgram (*Vigna mungo*) at varying levels of phosphorus. Crop Research 18(1): 163-165.

Mamathashree, C.M. (2014). Effect of foliar spray of water soluble fertilizers on growth and yield of pigeonpea [*Cajanus cajan* (L.) Millsp.]. M. Sc. (Ag.) thesis, University of Agricultural Sciences, Dharwad, India, 90p.

Manonmani, V. and Srimathi, P. (2009). Influence of mother crop nutrition on seed yield and quality of Blackgram. Madras Agricultural Journal. 96(1/6): 125-128.

MoA and FW [Ministry of Agriculture and Farmers Welfare]. (2021). Available:https://pib.gov.in/Press Release Iframe Page. aspx?PRID=1741992 [10 Dec. 2021].

Pooja, A.P., Ameena, M., Joseph, J. and Arunjith, P. (2023). Identification of low light tolerant Blackgram varieties with respect to morphophysiology and yield. Legume Research. 46(6): 671-677. doi: 10.18805/LR-4683.

Sakin, E. (2012). Organic carbon organic matter and bulk density relationships in arid-semi arid soils in southeast Anatolia region. African Journal of Biotechnology. 11(6): 1373-1377.

Sangwan, P.S. and Raj, M. (2004). Effect of zinc nutrition on yield of chickpea (*Cicer arietinum* L.) under dryland conditions. Indian Journal of Dryland Agricultural Research and Development. 19(1): 1-3.

Sridhara, M.R., Nandagavi, R.A., Nooliand, S.S. and Biradar, A.H. (2022). Influence of organic foliar application in chickpea (*Cicer arietinum* L.) under rainfed condition. Journal of Crop and Weed. 18(2): 56-63

Suman, B.M. (2018). Nutrient scheduling for upland rice intercropped in coconut (*Oryza sativa* L.). M.Sc. (Ag) thesis, Kerala Agricultural University, Thrissur. 154p.

Swaminathan, C., Surya, R., Subramanian, E. and Arunachalam, P. (2021). Challenges in pulses productivity and agronomic opportunities for enhancing growth and yield in Blackgram [*Vigna mungo* (L.) Hepper]: A review. Legume Research. 46(1): 1-9. doi: 10.18805/LR-4357.

Tabassum, D., Akhtar, A. and Inam, A. (2013). Effect of wastewater irrigation on growth, physiology and yield of mustard. International Journal of Botanical Research. 3: 27-34.

Thamburaj, S. (1991). Research Accomplishments in Tapioca at Tamil Nadu Agricultural University. In: [Gupta, A.K. (ed.)] Green Book on Tapioca. pp. 17.

Tohamy, W.A., El-Abagy, H.M., Badr, M.A., Abou-Hussein, S.D. and Helmy, Y.I. (2011). The influence of foliar application of potassium on yield and quality of carrot (*Daucus carota* L.) plants grown under sandy soil conditions. Australian Journal of Basic and Applied Science. 5(3): 171-174.

Wani, S.P., Pathak, P., Jangawad, L.S., Eswaran, H. and Singh, P. (2003). Improved management of vertisols in the semiarid tropics for increased productivity and soil carbon sequestration. Soil Use Management. 19(3): 217-222.

Zhang, X., Davidson, E.A., Mauzerall, D.L., Searchinger, T,D., Dumas, P. and Shen, Y. (2015). Managing nitrogen for sustainable development. Nature. 528: 51-59.