EFFECT OF FOLIAR APPLICATION OF MORINGA (*Moringa oleifera*) LEAF EXTRACT AND POTASSIUM ON YELID AND ECONOMICS OF BLACKGARM

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ABSTRACT

A field experiment was conducted during Rabi, 2023-24 at Krishi Vigyan Kendra, Palem, to evaluate the effect of foliar application of moringa (*moringa oleifera*) leaf extract (MLE) and potassium on yield and economics of blackgarm**.** The experiment was laid out in a Randomized Block Design with three replications. The results of this experiment revealed that application of 100% RDF + 20 kg MOP as basal + 8% MLE at 45 and 60 DAS recorded significantly higher number of pods plant^{-1} (25.23), test weight (42.87 g) and seed yield (1757 kg ha^{-1}). In terms of economic analysis, this treatment also exhibited the highest gross returns (₹ 1,47,588 ha^{-1}), net returns (₹ 93,119 ha^{-1}) and BC ratio (2.71). Conversely, the control recorded the lowest number of pods plant^{-1} (11.13), boll weight (28.96 g) and seed yield (572 Kg ha^{-1}), as well as lower gross returns (₹ 63,168 ha^{-1}), net returns (₹ 13858 ha^{-1}) and BC ratio (1.28). Based on these findings, it is recommended to adopt application of 100% RDF + 20 kg MOP as basal + 8% MLE at 45 and 60 DAS to achieve maximum yield and economic returns of blackgram. The economic analysis revealed that combined foliar application of MLE and potassium (MOP) was cost effective for maximizing seed yield and income.

Keywords*: Potassium; moringa leaf extract; yield and economics; blackgram*

1.INTRODUCTION

Pulses are the second most important crop in Indian agriculture after cereals due to their high protein content and significant role in human diet. Among the pulses, blackgram (*Vigna mungo*.L) is the third most important crop after bengalgarm and redgram. In India blackgram is popular is as Urd dal and is highly prized pulse among all the pulses. India is the major producer of black gram in the world and grown in almost all in all the states. India contributes more that 70% of world's black gram production. India has area of 46 lakhs hectares with the total production of about 24.5 lakhs tonnes of grain with a productivity of about 533 kg ha^{-1}.In Telangana, it is grown in about 38,564 hectares with the total production of 41,168 tonnes and the productivity of 1067 kg ha^{-1}.

A set of physio-chemical, biological and, integrated approaches is available for reducing yield losses (Bedada *et al.,* 2016). Among them, the use of organic (biostimulants) and inorganic nutrients are considered viable approaches to compensate yield losses. Bio stimulants are natural growth enhancers that stimulate crop yield via enhanced nutrient uptake and efficiency, improved tolerance to biotic and abiotic stresses and enhancement of the rhizospheric activities (Jardin, 2015).

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Moringa tree can be grown successfully in subtropical, semiarid, and tropical areas. Moringa grows well in dry sandy soil, along the coast, and in poor soil; it is a fast growing, drought resistant tree. It is a most nutritious plant, providing antioxidants and amino acids with antiaging and anti-inflammatory properties. This miracle tree is a rich source of calcium, iron, vitamin C, and highly digestible proteins All parts of moringa are consumed as food (Fahey, 2005, Moyo *et al*., 2011).The charisma of moringa leaf juice is a substance "zeatin" which is a natural plant growth hormone from the cytokinins group

and it has been reported that improvements in crop growth and yield results from the influence of zeatin (Phiri, 2010). Many studies are already reported regarding the use of moringa for agricultural purpose to enhance seed germination, growth and yield of agronomic crops.

Potassium (K) is major element which has important role in many plant processes and its application is usually abandoned causing nutrient imbalances that reduce crop yields. Soil and foliar feeding of K improves enzymatic systems, water use efficiency, protein formation, nitrogen assimilation and photosynthesis (Hussain *et al.,* 2021). Currently, farmers are conscious about inorganic fertilization to increase crop production and maintaining soil fertility but there is need to promote the use of organic fertilizers and explore safe, alternative and natural plant-based nutrients.

A few studies were conducted on the influence of MLE and potassium sources on the growth, yield and quality in different crops. It is hypothesized that exogenous application of MLE and sources of potassium may positively affect the growth, productivity and quality of blackgram.

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2. MATERIALS AND METHODS

2.1 Experimental Site

The field experiment was carried out at Krishi Vigyan Kendra, Palem during Rabi, 2023-24. The field is geographically located at 16°51'N Latitude, 78°25'E Longitude. Throughout the crop growth period, a total rainfall of 2 mm was received in 0 rainy days. The experimental soil was sandy loam with a neutral pH (7.02), EC (0.18dS m^{-1}), low in organic carbon (0.58 g kg^{-1}) and available N (141.6 kg ha^{-1}), medium in available P_2O_5 (32 kg ha^{-1}) and medium in available K_2O (228 kg ha^{-1}).

Moringa leaf extract~~s~~ (MLE) preparation and analysis:

Young leaves of moringa were harvested from a fully grown trees located at different places of the KVK, Palem. For preparation of MLE, young leaves of about 100g were taken into a mortar with a pinch of water (10ml/100g fresh material) and ground with a pestle. The juice was extracted by hand pressure and was filtered through the cheese cloth or cotton cloth. The solution was refiltered using Whatman No.2 filter paper. Following the method developed by Fuglie (2000), the extract was diluted with distilled water at ratio of 1:5 and 2:5 and then sprayed directly onto the blackgram plants.

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Table 1. Chemical composition analysis of moringa leaf extract

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Name of nutrient element/enzymes	Values
Total soluble protein (mg g−1)	1.40
Super oxide dismutase (SOD)	191.86
Peroxidase (POD)	21.99
Catalase (CAT)	7.09
Total phenolic contents (mg g^{-1})	8.19
Ascorbic acid (m mole g^{-1})	0.36
Gibberellins (mg g^{-1})	0.74

Zeatin (mg g^{-1})	0.96
Nitrogen (%)	1.933
Phosphorus (%)	0.180
Potassium (%)	2.187
Calcium (%)	2.433
Magnesium (%)	0.012
Zinc (mg kg^{-1})	38.333
Copper (mg kg^{-1})	3.50
Iron (mg kg^{-1})	544.0
Manganese (mg kg^{-1})	49.667
Boron (mg kg^{-1})	21.333

2.2 Experimental Details

The experiment was laid out in a Randomized Block Design with three replications during Rabi 2023-24, consisting of ten treatments with replicated thrice having net plot size of 4 x 6 m^2. The blackgram variety MGB 1070 was sown on sandy loam soil with a spacing of 30 cm×10 cm on 24thOctober 2023. Nitrogen was applied in the form of urea as per the treatments; potassium (50 kg ha^{-1}) was applied in the form of muriate of potash along with nitrogen and also as foliar spray in the form of KNO_3. Phosphorus was applied as basal dose in the form of SSP ~~and also as foliar spray in the form of KNO_3~~, moringa leaf extract was applied at 45 and 60 DAS as per treatments, all recommended agronomic practices and plant protection measures were taken as per requirement. The recommended dose of fertilizers: 20 kg N, 50 kg P_2O_5 and 0 kg K_2O per hectare.

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The current study comprised of 100% RDF, potassium nitrate @ 0.5% (foliar spray), muriate of potash 20kg (as basal) alone and combined with foliar spray of Moringa Leaf Extract (MLE) keeping tap water spray as a control, Bio stimulant was foliar applied twice was assessed at 30, 45 DAS. The parameters were compared between treatments with moringa leaf extract application (at 30 and 45 DAS) and those without moringa leaf extract, under potassium source and 100% RDF.

Treatment details of the experiment

T_1: Control

T_2: 100%RDF

T_3: 100% RDF+ 20 kg MOP as basal

T_4: 100% RDF + 0.5% Potassium Nitrate as foliar spray at 45 DAS

T_5:T_2+ 4% MLE at 30 and 45 DAS

T_6:T_3+ 4% MLE at 30 and 45 DAS

T_7:T_4+ 4% MLE at 30 and 45 DAS

T_8:T_2+ 8% MLE at 30 and 45 DAS

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T_9:T_3+ 8% MLE at 30 and 45 DAS

T_{10}:T_4+ 8% MLE at 30 and 45 DAS

2.3 No. of Pods Plant^{-1}

The number of pods from the five plants within the net plot was counted at harvest. These individual counts were then averaged and expressed as the number of pods per plant.

2.4 Seeds pod^{-1}

The number of seeds per pod was measured from the five pods within the net plot was counted. These individual counts were then averaged and expressed as the number of seeds per pods.

2.5 Test Weight (g)

The seed yield obtained from ten bolls at random in each net plot was weighed, averaged and expressed as boll weight in grams.

2.6 Seed Yield (kg ha^{-1})

Seed obtained from each treatment in a net plot was weighed using an electronic balance. The seed yield from net plots in each treatment was weighed in g plot^{-1} and yield was converted to kg ha^{-1}.

2.7 Cost of Cultivation

The cost of cultivation was worked out on the basis of existing local prices of different inputs i.e., labour, seed, fertilizers and chemicals etc.

2.8 Gross Returns

It was assessed by multiplying the yield with prevailing market price.

2.9 Net Returns

Net returns were calculated by subtracting the cost of cultivation from gross returns.

2.10 Benefit Cost Ratio

Benefit cost ratio was calculated by dividing gross returns with cost of cultivation.

2.11 Statistical Analysis

Statistical analysis was carried out following the procedure of ANOVA for randomized block design as suggested by Panse and Sukhatme.

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3. RESULTS AND DISCUSSION

3.1 Number of Pods Plant^{-1}

Among all the treatments, maximum no. of bolls plant^{-1} were recorded with 100% RDF+ 20kg MOP as basal+ 8% MLE at 30 and 45 DAS (25.23) and the lowest no.of pods plant^{-1} were recorded in T1: control (11.13).Number of pods harvested per plant differed significantly due to foliar spray of MLE

and various sources of potassium on blackgram (Table 2). Higher number of pods per plant was observed with the application of MLE and potassium nitrate. Among all treatments, the treatment that receives potassium as MOP recorded significantly the highest growth and yield of blackgram when compared with foliar treatments. Irshad *et al*. (2022), confirmed that combined application of MLE+K produced maximum pods per plant, grain weight, grain yield and harvest index.

3.2 Seeds/pod

Among all the treatments, maximum seeds/pod were recorded with 100% RDF+ 20kg MOP as basal+ 8% MLE at 30 and 45 DAS which is on par with 100%RDF+ 0.5% Potassium Nitrate as foliar spray + 8% MLE at 30 and 45 DAS, 100%RDF+ 8% MLE at 30 and 45 DAS, 100%RDF+ 20kg MOP as basal+ 4% MLE at 30 and 45 DAS, 100%RDF+ 0.5% Potassium Nitrate as foliar spray + 4% MLE at 30 and 45 DAS, 100%RDF+ 4% MLE at 30 and 45 DAS and 100% RDF(Table 2). The lowest was recorded in control.Seeds/pod was not influenced by the application of moringa leaf extract and source potassium which might be due to characters highly influenced by its genetic makeup.

3.3 Test Weight (g)

Test weight was significantly influenced by potassium and moringa leaf extract in which maximum boll weight was recorded with the application of 100% RDF+ 20kg MOP as basal+ 8% MLE at 30 and 45 DAS (42.87g) which is on par with T10, T8, T7, T6 and T5(Table 2).Application of 8% MLE combined with potassium produced the highest values of test weight/plot with no significant differences with both 4 and 8% concentrations of MLE mixed with potassium source.Moreover, yield components of mung bean (number of pods, pod dryweight, seed dry weight and shelling out turn) were positively affected by high concentration of MLE (Abohassan and Abusuwar., 2017).

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Table 2: Growth parameters of blackgram influenced by Moringa (*Moringa Oleifera*) Leaf Extract and potassium

Treatments	Plant height (cm)	No. of active nodules	No. of branches /plant	SPAD meter
T_1:Control	17.04	9.15	2.80	48.11
T_2:100% RDF	21.25	12.18	3.47	50.94
T_3:100% RDF +20kg MOP as basal	21.50	13.36	3.70	51.31
T_4:100% RDF +0.5%Potassium Nitrate foliar spray	21.49	13.15	3.60	51.27
T_5:T_2+4% MLE at 45 and 60 DAS	24.42	13.41	3.87	52.13
T_6:T_3+4% MLE at 45 and 60 DAS	24.44	13.54	4.07	52.20
T_7:T_4+4% MLE at 45 and 60 DAS	24.46	13.80	4.13	52.80

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T_8:T_2+8% MLE at 45 and 60 DAS	27.47	14.44	4.23	54.47
T_9:T_3+8% MLE at 45 and 60 DAS	30.21	15.89	5.65	56.55
T_{10}:T_4+8% MLE at 45 and 60 DAS	27.55	14.45	4.50	54.89
CD (P=0.05)	4.37	NS	NS	NS
SEM±	1.47	0.47	0.30	1.13

3.4 Seed Yield (kg ha^{-1})

A perusal of the data recorded on seed yield reported that there was a significant influence of moringa leaf extract and potassium source on blackgram seed yield (Table 3). Highest seed yield was recorded with 100% RDF+ 20kg MOP as basal+ 2 sprays of 8% MLE at 30 and 45 DAS (2484 Kg ha^{-1}) which is on par with 100% RDF+ 0.5% Potassium Nitrate as foliar spray + 8% MLE at 30 and 45 DAS (seed yie). The other treatments T_6, T_8, T_3, T_7, T_4, T_5 and T_2 recorded seed yield1529kgha^{-1},1461kgha^{-1},1454kgha^{-1},1397 kgha^{-1},1395 kgha^{-1},1362 kgha^{-1} and 1347 kgha^{-1}. Conversely, the lowest seed cotton yield was recorded with control. Seed yield is influenced by a number of factors, which have a direct or indirect impact. The factors which have direct influence on seed yield are the yield components *i.e.,* no. of pods plant^{-1} seeds/pod and test weight.Several researchers found similar results with different crops (Mvumi *et al*., 2012 and Emongor, 2015) in onion and kidney beans, Muhamman *et al*. (2013) in tomato, Abdalla (2013) in rocket.

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Table 3. Seed yield (kg ha^{-1}) and Stover yield (kg ha^{-1}) of blackgram influenced by Moringa (*Moringa Oleifera*) Leaf Extract and potassium

Treatments	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})
T_1:Control	752	1434
T_2:100% RDF	1347	2345
T_3:100% RDF +20kg MOP as basal	1454	2443
T_4:100% RDF **+**0.5%Potassium Nitrate foliar spray	1395	2380
T_5:T_2+4% MLE at 45 and 60 DAS	1362	2361
T_6:T_3+4% MLE at 45 and 60 DAS	1529	2414
T_7:T_4+4% MLE at 45 and 60 DAS	1397	2365
T_8:T_2+8% MLE at 45 and 60 DAS	1461	2441
T_9:T_3+8% MLE at 45 and 60 DAS	1757	2738
T_{10}:T_4+8% MLE at 45 and 60 DAS	1527	2510
CD (P=0.05)	200.49	209.89
SEM±	67.48	70.64

3.5 Economics

The data pertaining to economic parameters indicated in Table 4.

3.5.1 Cost of cultivation (₹ ha^{-1})

Cost of cultivation varied from ₹54469 ha^{-1} to ₹ 49310 ha^{-1}. Higher cost (₹ 54469 ha^{-1}) was incurred due to application of 100% RDF+20 kg MOP as basal+8% MLE at 45 and 60 DAS (Table 4). The deviation in cost of cultivation was due to nitrogen fertilizer level, man power required for application of fertilizer and MLE, Manual Harvesting and Threashing charges in case of high seed yield is also contributed towards escalated cost of cultivation.

3.5.2 Gross returns (₹ ha^{-1})

Perusal of data on gross returns indicated that higher gross returns (₹ 1,45,788 ha^{-1}) were observed with application of 100% RDF+20 kg MOP as basal+8% MLE at 45 and 60 DAS over rest of the treatments which was due to higher seed yield obtained in this treatment. While, lower gross returns were recorded with control (₹ 63,168 ha^{-1})(Table 42).

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3.5.3 Net returns (₹ ha^{-1})

Net returns obtained from blackgram were found to be higher with application of T9: 100% RDF+20 kg MOP as basal+8% MLE at 45 and 60 DAS (₹ 93,119 ha^{-1}) While, significantly lower net returns (₹ 13,858 ha^{-1}) were registered with application of T1: control. Higher net returns were due to higher seed yield obtained per hectare (Table 4). Exogenous application of different sources of potassium improved the productivity and net income. (Yasmeen et al., 2018).

3.4 Benefit Cost Ratio

An over view of data among treatments showed that higher B.C ratio (2.71) was recorded with T9: 100% RDF + 20 kg MOP as basal + 8% MLE at 30 and 45 DAS and lower B.C ratio (1.28) was recorded with T1: control. The higher benefit cost ratio was due to higher seed yields and net returns over other treatments (Table 4).

Table 4: Economics of blackgram as influenced by Moringa leaf extract and potassium ~~under blackgram~~

Treatments	COC (₹ ha^{-1})	GR (₹ ha^{-1})	NR (₹ ha^{-1})	B:C
T_1:Control	49310	63168	13858	1.28
T_2:100% RDF	52069	113148	61079	2.17
T_3:100% RDF +20kg MOP as basal	53269	122136	68867	2.29
T_4:100% RDF + 0.5%Potassium Nitrate foliar spray	52819	117180	64361	2.22

T_5:T_2+4% MLE at 45 and 60 DAS	53269	114408	61139	2.15
T_6:T_3+4% MLE at 45 and 60 DAS	54469	128436	73967	2.36
T_7:T_4+4% MLE at 45 and 60 DAS	54019	117348	63329	2.17
T_8:T_2+8% MLE at 45 and 60 DAS	53269	122724	69455	2.30
T_9:T_3+8% MLE at 45 and 60 DAS	54469	147588	93119	2.71
T_{10}:T_4+8% MLE at 45 and 60 DAS	54019	128268	74249	2.37

4.CONCLUSION

Blackgram (Vigna munga L.), the most important pulse crop is grown throughout India. The productivity of blackgram in India is relatively low compared to the world's average productivity. Nowadays for improving productivity foliar spraying of nutrients plays a major role. The available synthetic formulations foe foliar spraying was highly expensive. Hence, the leaf extracts of tropical trees can be utilized as an alternative source since they have enormous bioactive compounds able to stimulate plant growth and improve productivity without any harmful effects. Based on these findings, it is recommended to adopt application of 100% RDF + 20 kg MOP as basal + 8% MLE at 45 and 60 DAS to achieve maximum yield and economic returns of blackgram.

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