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Influence of sulphur and bio-inoculants on yieldand economics of black gram (*vignamungo* L.)"

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Abstract: *The field investigation entitled"Influence of sulphur and bio-inoculants on growth, yield and quality of black gram (*Vignamungo L.*)" wasconductedat Instructional Farm, Department of Agronomy, College of Agriculture, Latur. The expérimental fieldwasleveled and welldrained. The soilwasclayloam in texture, low in availablenitrogen, medium in phosphorus, high in potassium, low in sulphur and slightlyalkaline in reaction.*

The experimental plot was laid out in a randomized block design with eight treatments. Each experimental unit was repeated three times. The recommended variety BDU-1 of blackgram was tested for this experiment. The treatments were T_1*- RDF (25:50:00),* T_2 *-RDF + 20 kg S ha*$^{-1}$*,* T_3 *- RDF + 20 kg S ha*$^{-1}$ + Rhizobium*,* T_4*- RDF + 20 kg S ha*$^{-1}$ *+ PSB,* T_5 *- RDF + 20 kg S ha*$^{-1}$ + Thiobacillus*,* T_6 *- RDF + 20 kg S ha*$^{-1}$ + Rhizobium + Thiobacillus*,* T_7 *- RDF + 20 kg S ha*$^{-1}$ *+PSB* + Thiobacillus *and* T_8 *- RDF + 20 kg S ha*$^{-1}$ *+PSB* + Rhizobium + Thiobacillus*. The gross and net plot size was 5.4 x 4.2 m*^{2} *and 4.4 x 3.0 m*^{2} *respectively. Sowing was done on 4*th *July, 2013 by dibbling method with spacing of 30 x 10 cm*^{2}*. Seed treatment of different bio-inoculants was done on seeds according to the treatment details. The recommended cultural practices and plant protection measures were taken.*

The highest seed yield, gross and net monetary returns with higher B:C ratio of blackgram crop grown in Kharif *2013 was obtained with application of RDF along with sulphur (20 kg ha*$^{-1}$*) and seed treated with bio-inoculants (*Rhizobium*, PSB and* Thiobacillus*) while higher harvest index was observed with application of RDF along with sulphur (20 kg ha*$^{-1}$*) and seed treatment of* thiobacillus.

Keywords: *Sulphur, Bio-inoculantsYield and Economics.*

INTRODUCTION

Black gram (*Vignamungo*L.) is popularly known as 'urd bean'. It is one of the important pulse crop grown in India which belongs to the genus '*vigna*' and family '*Leguminoseae*'. It is originated in India. It is one of the most highly prized pulse crop. Pulses are the cheapest source of quality protein for the human being. The protein hunger is common problem in India, where majority of the people have vegetative diet. In general, pulses have two to three times more protein than the cereals or any other group of plants.

In India, 22.92 million hectares land is under pulse cultivation which accounts 14.31 million tonnes of production. The productivity of pulse crop in India is about 625 kg ha^{-1}. Among the *kharif*season pulses occupy 10.65 million hectares area with total production of 4.99 million tonnes. The average productivity of *kharif* season pulse is 469 kg ha^{-1}.India rank first in production of black gram.Area and production of black gram under Maharashtra during 2010-2011 was 502 ('000 Ha) and 333 ('000 MT.).

Sulphur is one of the essential plant nutrients and it contributes to yield and quality of crops. Sulphur is now recognized as the fourth major plant nutrient, along with nitrogen (N), phosphorus (P) and potassium (K). Unlike nitrogen, Sulphur

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deficiency symptoms appears first on younger leaves and persist even after nitrogen application. Sulphur has number of oxidizing function in plant nutrition and is best known for its role in protein synthesis. Sulphur has synergistic relationship with N, P, K, Mg and Zn.

The microbial inoculants are becoming popular in India and abroad as these are cheap, simple to use and have no ill effects. Various bio- inoculants are used to increase availability of sulphur in soil for plants. Blackgram responded significantly to inoculation of *Rhizobium* to seeds, phosphorous and sulphur application. Application of bio fertilizer is an acceptable approach for increasing yield with good quality and for human consumption. Under *Rhizobium* inoculation, plants synthesize more photosynthates and enhanced the protein content in grain and nodulation in plants.

Phosphate dissolving microorganisms have capacity to render insoluble form of phosphate more available to plants besides, metabolic products of soil microbes such as organic acids and humic substances. The use of phosphate solubilising bacteria (PSB) as inoculants simultaneously increases P uptake by the plant and crop yield. Strains from the genera *Pseudomonas*, *Bacillus* and *Rhizobium* are among the most powerful phosphate solubilizers. The principal mechanism for mineral phosphate solubilisation is the production of organic acids, and acid phosphatases play a major role in the mineralization of organic phosphorous in soil. The PSB, like *Pseudomonas striata* bacterial inoculation was found as equivalent to supply 50 kg P_2O_5 ha^{-1} through single super phosphate.

Most of agricultural soils contain some micro organisms that are able to oxidise sulphur. The most important organism in this respect are a group of bacteria belonging to the genus Thiobacillus. *Thiobacilli* play an important role in sulphur oxidation in soil. Sulphur oxidation is the most important step of sulphur cycle, which improves soil fertility. It result in the formation of sulphate (SO_4), which can used by the plants.In order to increase the availability of sulphur and increase the yield of black gram, the experiment was undertaken.

MATERIALS AND METHODS

The present investigation "Influence of sulphur and bio-inoculants on growth, yield and quality of black gram (*Vignamungo L.*)" was conducted at Agronomy farm, College of Agriculture, *Latur*,(M.S.) during *Kharif* season of 2013. The soil of the experimental plot was clay loam in texture, slightly alkaline in pH (8.27) and low in organic carbon (0.63) content. It was low in available nitrogen (193.5), medium in available phosphorus (11.82),high in available potassium (333.78) and low in sulphur (15.40). The experiment was laid out in randomized block design consisting eight treatments *viz*., T_1- RDF (25:50:00), T_2 -RDF + 20 kg S ha^{-1}, T_3 - RDF + 20 kg S ha^{-1} + *Rhizobium*, T_4- RDF + 20 kg S ha^{-1} + PSB, T_5 - RDF + 20 kg S ha^{-1} + *Thiobacillus*, T_6 - RDF + 20 kg S ha^{-1} + *Rhizobium* + *Thiobacillus*, T_7 - RDF + 20 kg S ha^{-1} +PSB + *Thiobacillus* and T_8 - RDF + 20 kg S ha^{-1} +PSB + *Rhizobium* + *Thiobacillus*. and replicated three times.

The experimental plot was ploughed once and harrowed twice to obtain the good tilth. The experimental field was laid out as per the plan of layout. Recommended dose of fertilizers (25:50:00 NPK kg ha^{-1}) and sulphur was applied as basal dose and seed treatment with different bio-fertilizers (*Rhizobium, Thiobacillus* and PSB) were given as per treatments. The nutrients were applied through Urea, DAP and Bensulph (Elemental Sulphur). The seeds were treated with PSB, *Thiobacillus* and *Rhizobium* according to treatment details and sowing was done by dibbling method on 4th July 2013. Two seeds were dibbled at each hill at 35 x 10 cm distance. Gap filling was done on 7 DAS and thinning was done 15 DAS by keeping one healthy seedling at each hill. One hand weeding and one hoeing was carried out to control weeds and conserve soil moisture. One spray of Monocrotophos at 21 DAS and one spray of Cypermethrinat 45 DAS were undertaken to control sucking pests and pod borer. At maturity (75 DAS) the crop was harvested manually by picking the dry pods from net plot separately as per the treatments and threshing was done manually. After winnowing, clean seeds were sundried for three days and weighed as per the treatments.

For recording biometric observations five plants were selected at random from each net plot. The emergence of seedlings was observed at six days after sowing and the total plant count was taken at 15 days after sowing. The final plant stand was recorded at the time of harvesting. Height of plant were measured from ground level to the base of last fully opened leaf and average height was work out. The total number of trifoliate leaves were counted and recorded. Number of branches per plant grown on stem were counted and recorded. Leaf area were calculated by using formula. A single plant was randomly sampled from each plot for dry matter production. Numbers of pods were counted from 5 randomly selected plants from net plots and then the average was worked out. Data on growth parameters *viz.* AGR for height and AGR and RGR for dry matter per plant was further analyzed for working out the growth functions. The plants selected for biometric observations were used for generating yield attribute. Total numbers of pods from five selected sample plants were harvested and per plant seed yield was recorded. Thousand seeds were counted from each net plot seed yield and its weight was recorded.The plants from each net plot were harvested and seeds were separated by threshing. After sun drying seed yield obtained in each net plot were weighed in kg and presented as kg ha^{-1}.Straw yield was obtained by deducting the seed yield from the weight of total dry produce (biological yield) of respective net plot in kg and given as kg ha^{-1}. The figures of biological yield were calculated by summing of seed yield and straw yield of net plots. Finally it was converted on hectare basis. The harvest index was calculated by using formula Total seed yield (kg ha^{-1}) divided by Total biological yield (kg ha^{-1}) in to 100.

RESULT AND DISCUSSION

Data on seed yield, straw yield, biological yield and harvest index as influenced by different treatments is presented in Table 1. It is observed that the mean seed yield, straw yield, biologicalyield and harvest index were1135, 1355, 2490 (kg ha^{-1}) and 45.51 % respectively.

Data presented in table 1 revealed that application of RDF with 20 kg S $ha^{-1}$and treating seeds with Bio-inoculants (*Rhizobium* + *PSB* + *Thiobacillus*) (T_8) recorded highest seed yield (1250 kg ha^{-1}), straw yield (1464 kg ha^{-1}) and biological (2703 kg ha^{-1}) yield which was found significantly superior over the treatment of RDF (T_1), RDF + 20 kg S ha^{-1} (T_2) and RDF + 20 kg S ha^{-1} + PSB inoculants (T_4) and was found at par with rest of the treatments. It may be due to vigorous start to plant and strengthen straw by combine effect of bio-inoculants and more availability if N, P and S. These results are supported by Gupta et al., (2006), Ahmed *et al*., (2006)Dhage and Kachhave (2008) and Patel *et al*., (2013). Data of harvest index presented in Table 1 revealed that the

Table 1
Seed yield, straw yield, biological yield and harvest index as influenced by different treatments.

Treatments	*Seed yield (kg ha^{-1})*	*Straw yield (kg ha^{-1})*	*Biological yield (kg ha^{-1})*	*Harvest index (%)*
T_1- RDF	900	1226	2126	42.33
T_{2-} RDF + 20 kg S ha^{-1}	1049	1287	2335	44.92
T_{3-} RDF + 20 kg S ha^{-1} + *Rhizobium*	1131	1341	2472	45.75
T_{4-}RDF + 20 kg S ha^{-1} + PSB	1101	1308	2409	45.70
T_5- RDF + 20 kg S ha^{-1} + *Thiobacillus*	1193	1348	2541	46.95
T_{6-} RDF + 20 kg S ha^{-1} + *Rhizobium* + *Thiobacillus*	1239	1435	2674	46.33
T_{7-}RDF + 20 kg S ha^{-1} + PSB+*Thiobacillus*	1217	1435	2652	45.88
T_{8-}RDF + 20 kg S ha^{-1} + *Rhizobium* + PSB +*Thiobacillus*	1250	1464	2703	46.24
SE$\pm$	44.02	47.73	85.48	-
CD at 5%	133.50	144.76	259.27	-
General Mean	1135	1355	2490	45.51

Table 2
Mean gross monetary returns, net monetary returns,cost of cultivation and Benefit : Cost (B : C) ratio as influenced by different treatments.

Treatments	*Gross monetary returns ('ha^{-1})*	*Cost of Cultivation ('ha $^{-1}$)*	*Net monetary returns ('ha $^{-1}$)*	*B:C Ratio*
T_1- RDF	37800	19742	18058	1.91
T_{2}- RDF + 20 kg S ha^{-1}	44058	20631	23427	2.13
T_{3}- RDF + 20 kg S ha^{-1} + *Rhizobium*	47502	20661	26841	2.29
T_{4}-RDF + 20 kg S ha^{-1} + PSB	46242	20661	25581	2.23
T_5 - RDF + 20 kg S ha^{-1} +*Thiobacillus*	50106	20691	29415	2.42
T_{6}- RDF + 20 kg S ha^{-1} +*Rhizobium* +*Thiobacillus*	52038	20721	31317	2.51
T_{7}-RDF + 20 kg S ha^{-1} +PSB +*Thiobacillus*	51114	20721	30393	2.46
T_{8}-RDF + 20 kg S ha^{-1} +*Rhizobium* + PSB +*Thiobacillus*	52500	20751	31749	2.53
SE$\pm$	1848	-	1848	-
CD at 5%	5607	-	5607	-
General Mean	47670	20572	27098	-

highest harvest index (46.95) was observed when RDF was applied along with 20 kg S ha^{-1} and seeds were treated with *Thiobacillu*s inoculants.

Regarding economics of the treatments, treatment RDF + 20 kg S ha^{-1} + bio inoculants treatment (*Rhizobium* + PSB + *Thiobacillus*) (T_8)resulted in significantly maximum , gross returns (Rs. 52500 ha^{-1}) , net returns (Rs. 31749 ha^{-1}) , and B: C ratio (2.46), over rest of the treatments, except treatments RDF (T_1), RDF + 20 kg S ha^{-1}(T_2) and RDF + 20 kg S ha^{-1} + PSB inoculation (T_4) which were similar with each other.This may be due higher economic yield obtained with the combined effect of N, P, S and other bio-inoculants. These results are similar with those ofVed ram*et al*., (2008).

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