Contract Trial Report

Evaluation of "CROPMATE" Microbial Formulation on Nodulation, Growth and Yield of Soybean

Sponsored by M/s Zytex Biotech Pvt Ltd. Savli, Vadodara- 3091775

Carried Out By

ICAR-Indian Institute of Soybean Research
Khandwa Road- Indore

Period-Kharif 2016

ICAR-INDIAN INSTITUTE OF SOYBEAN REASEARCH
Khandwa Road- Indore

Project No……
Project Tile: Evaluation of "CROPMATE" Microbial Formulation on Nodulation, Growth and Yield of Soybean

Background

"Cropmate" is a formulation containing beneficial Plant Growth Promoting Rhizobacteria (PGPR) which colonizes the roots and promotes plant growth and increase productivity either through direct action or via biological control of plant diseases. Inoculation of this product stimulated directly through increase in nutrition acquisition, such as phosphate solubilization, or more generally by rendering the inaccessible nutrients available to the plants. Also helps in improving crop productivity up to 15 - 20 %.

Present trial was conducted to determine the-

(i) Response of CROPMATE microbial formulation to nitrogen fixation in soybean
(ii) Responses of product on fertilizers use efficiency on soybean

Materials and Methods

The field (Vertisols, soil type, Sarol series) trial was conducted during *Kharif* 2016 at Research Farm of Indian Institute of Soybean Research, Indore. The product **'CROPMATE'** was applied as basal or in split or as seed treatment doses as soil application as per the following treatments-

Treatments

1. Control (Recommended dose of fertilizers (RDF) @ 20:26.2:16.6 kg NPK/ha as basal dose)
2. CROPMATE application as seed treatment @15gm/kg seed along with RDF
3. CROP MATE @ 1kg/acre as soil application along with RDF*
4. CROP MATE Spilt dose (1 Kg/acre soil application at sowing and 1 Kg/Acre at 30DAS +RDF
5. 2 + 3
6. 2 + 4
7. 5 + 75% RDF
8. 6 + 75% RDF
9. Recommended dose of fertilizers (RDF) @ 20:26.2:16.6 kg NPK/ha as basal dose+0.5 kg Cropmate + 0.5 kg P'rise at sowing and 0.5 kg each at 30 DAS

*soil application of CROPMATE to be mixed with FYM@ 20Kg/acre for all the treatments

No herbicide and insecticide was applied during the experiment however, to control white flies' one spray of Coragen was applied.

Soybean Cultivar: **JS 95-60**
Design: RBD
Replications: Three
Plot size: 3.6m $\times$ 5m = 18.0 m^2

Sampling and Analyses

Agronomic parameters were recorded during crop stand (soybean JS 95-60) and at harvest. Standard recommended agronomic practices were followed throughout the experimentation to maintain the crop. No weedicides was applied to eradicate weeds; however, weeds were removed by two hand weeding. Number of flowers, nodules per plant was recorded during crop stand and at harvest; total dry biomass of crops (straw + seed) and seed yield were recorded in each plot and extrapolated on per hectare basis. To assess the efficacy of product, the total nitrogen and phosphorus was assessed both in seeds and shoot/straw samples using standard procedures.

The data were analyzed using the analysis of variance. The least significant differences (LSD) were used to separate the treatment means using DMRT test (COSTAT statistical software, Cohart, Berkeley, California).

Observations

1. At emergence, % germination
2. Flower initiation (Day to flower) & Number of flower/plant
3. Shoot biomass per plant at 50% flowering
4. Nodule number; Nodule dry weight & N content of the nodule/ ARA
5. N, P content in the seed & straw at harvest
6. Protein content in seeds
7. Grain yield /per acre
8. Visual observations on biotic and abiotic stresses during the trial

Results

The conclusions based on the results of ANOVA test (Table 1) can be summarized as follows:
The inoculation of product showed significant positive impact on flower number, maximum being in case of split dose application of CROPMATE in the soil along with recommended dose of fertilizers (T4). Flower number was however lowest when seed treatment was combined with split soil application along with 75% recommended dose of fertilizers (T8), as also when only recommended dose of fertilizers was applied with no inoculum (T1).

Shoot biomass was again the maximum in case of combined seed and soil application of CROPMATE along with recommended dose of fertilizers (T5) and minimum when the inoculum was applied only to the soil in split doses along with recommended dose of fertilizers (T4).

Nodule number was found to be the maximum when combined doses of both the products were applied along with recommended dose of fertilizers (T9) but found to be at par with combined application as seed treatment along with split dose application at 75% RDF (T8). The lowest no. was recorded in the control (only RDF) plots.

The nodule dry weight, however, was the maximum in case of both seed treatment and soil application along with 75% recommended dose of fertilizers (T8) and minimum when no inoculum and only recommended dose of fertilizers was applied (T1).

The inoculum caused significant increase in the leghemoglobin content of nodules, maximum being in case of combined seed treatment and split soil application of inoculum along with recommended dose of fertilizers (T6) and was at par with seed treatment and soil application. It was the minimum when only recommended dose of fertilizers was applied without inoculum (T1).

Consequently, nitrogen content of nodules and seed was no significantly enhanced by the product application. It was however, maximum in case of seed treatment combined with soil application of the inoculum along with recommended dose of fertilizers (T5). Overall there was no significant differences were observed amongst treatments however, control plots showed lower values. Similar trend was observed in case of protein content in seeds.

There was no significant impact of the treatments on phosphorus content of seeds, this year as well. However, it was marginally highest in case of split soil application of inoculum along with recommended dose of fertilizers (T4) and also when seed treatment was combined with soil application along with recommended dose of fertilizers (T5). It was again, lowest in case of seed treatment along with recommended dose of fertilizers (T2).

The phosphorus content of straw was affected by the treatments. It was the maximum in case of combined soil application of both the inocula along with recommended dose of fertilizers (T9). Lowest phosphorus content was found in cases of control and seed application (T1 and T2) plots.

The nitrogen content of straw was found to be the maximum in case of soil application (T3) and split soil application (T4), both along with recommended dose of fertilizers. It was the minimum in RDF alone control plots (T1).

The application of product influenced grain yield significantly. Overall all treated plots did produce higher yield when compared to control/RDF alone plots. The yield was found to be highest in case of soil application along with split dose of fertilizers (T4) and T6 (seed treatment +split soil application) followed by in T8 (T2+T4) at 75% RDF. ***The combined application of both CROPMATE and P'RISE did not yield better when compared to control and other treatments. Overall considering two years response, when Cropmate was applied either as soil application***

(singly or in split doses) at RDF dose produced highest yield when compared to control and other combinations. However, when Cropmate applied as seed treatment along with split soil application at 75% RDF was also found to be economical and save fertilizer inputs without compromising the yield significantly.

Table.1: Effect of Cropmate on nodulation, N & P uptake, accumulation in seeds and grain yield of soybean (JS 95-60) under field conditions

Trts	No. of flowers/ plant	Shoot biomass (g/plant)	Nodule no/plant	Nodule Dry Wt (g/plant)	LegHb in Nodules (mg g^{-1})	% N in nodule	% N in seed	% P in seed	% N in straw	% P in straw	% Protein in seeds	Grain Yield (kg/ha)	Consolidated yield** (kg/ha)
1	12.33 e	2.66 abc	28.40 b	0.16 d	10.97 d	3.39 bc	6.79 ab	0.46 a	0.17 d	0.03 bc	39.38 ab	1915.94c	1352.23
2	18.00 ab	2.67 abc	30.53 ab	0.82 ab	15.95 ab	3.64 ab	6.93 a	0.46 a	0.36 b	0.02 cd	40.19 a	2237.92b	1515.22
3	15.67 bcd	2.89 abc	33.80 ab	0.83 a	15.03 ab	3.49 bc	5.67 b	0.49 a	0.48 a	0.05 b	32.89 b	**2541.25a**	**1689.20**
4	19.33 a	2.00 c	32.00 ab	0.78 ab	12.81 cd	3.64 ab	6.49 ab	0.52 a	0.48 a	0.02 cd	37.62 ab	**2544.59a**	**1634.38**
5	15.00 b	3.56 a	32.70 ab	0.66 b	14.08 bc	3.85 a	7.42 a	0.52 a	0.18 d	0.03 cd	43.04 a	2384.17ab	1611.53
6	12.67 de	3.33 ab	30.30 ab	0.48 c	16.96 a	3.53 bc	7.21 a	0.50 a	0.39 b	0.02 d	41.82 a	**2503.54ab**	**1624.36**
7	14.40 cde	2.34 c	29.87 ab	0.71 ab	16.77 a	3.51 bc	6.65 ab	0.51 a	0.46 a	0.03 cd	38.57 ab	2274.38b	1526.63
8	12.00 e	2.44 bc	35.47 ab	0.85 a	12.59 cd	3.50 bc	6.51 ab	0.50 a	0.30 c	0.04 bc	37.76 ab	**2476.46a**	**1636.29**
9	16.33 bc	2.33 c	36.73 a	0.19 d	12.76 cd	3.30 c	6.72 ab	0.49 a	0.18 d	0.07 a	38.98 ab	1815.28c	-
LSD (0.05)	2.84	0.86	7.29	0.15	2.04	0.29	1.09	0.12	0.06	0.01	6.33	186.57	

*Data are average of three replications; LSD, least significance different; Means followed by same letter did not differ significantly by DMRT (ANOVA, P=0.05).
Treatments where-
T1-Control (Recommended dose of fertilizers (RDF) @ 20:26.2:16.6 kg NPK/ha as basal dose); T2-CROPMATE application as seed treatment @15gm/kg seed along with RDF; T3-CROP MATE @ 1kg/acre as soil application along with RDF; T4-CROP MATE Spilt dose (1 Kg/acre soil application at sowing and 1 Kg/Acre at 30DAS +RDF; T5-T2 + T3; T6-T2 + T4; T7-T5+75% RDF; T8-T6+75% RDF; T9-Recommended dose of fertilizers (RDF) @ 20:26.2:16.6 kg NPK/ha as basal dose+0.5 kg Cropmate + 0.5 kg P'rise at sowing and 0.5 kg each at 30 DAS: ** average yield of two years