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ORIGINAL ARTICLE

Impact of Liquid Organic Fertilizers with Foliar Application on Growth, Yield and Quality of Soybean (*Glycine max* L.)

Sarthak Verma and Moinuddin
Department of Agronomy, School of Agricultural Sciences
Shri Guru Ram Rai University, Dehradun, Uttarakhand, India
Corresponding author's email id: moin.agronomy@gmail.com

ABSTRACT
A field experiment was carried out at Research Farm of SGRR University, Pathri Bagh, Dehradun, India, during 2023 and data was evaluated of experimental trial with a goal of evaluating the Impact of Liquid Organic Fertilizers with Foliar Application on Growth, Yield and Quality of Soybean [(Glycine max L.) Merril]. The experiment was laid down in Randomized Block Design (RBD) comprising of three replications and twelve treatments. Recommended doses of fertilizers (RDF) was applied as basal application to all the treatments. The result of the study revealed that Treatment T_{11} (Vermiwash at 5% Foliar application + Beejamrit at 5% Foliar application + Panchgavya at 5% Foliar application + Neem Leaf Extract at 5% Foliar Application) have showed significant increase in both growth and yield parametres viz Maximum Plant Height (74.46 cm), Number of Branches (8), Effective Root Nodules (67), Plant Dry Weight (66.53 g) , Crop Growth Rate (.74 gm/m²/day), Relative Growth Rate (0.02 g/g/day) and Yield attributing parameters like Number of seed/pod (3), Number of Pods per (71.66) as well as Seed yield (594.61 kg/ha), Straw yield (915.31 kg/ha), Oil Content (19.95%), Protein Content (39.98 %) Harvest Index (39.33%) while the lowest growth and yield parameters was found in Control (T_0).
***Keywords**: Soybean; Natural Farming; Beejamrit; Panchgavya; Neem Leaf Extract; Vermiwash; Seed Yield; Organic Farming.*

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INTRODUCTION

Soybean (*Glycine max* L. Merrill) is a beneficial oilseed pulse crop of country as well as the world. It is designated as wonder crop of current century and called as "Golden Bean". Soybean is the cheapest source of quality protein and it is called "Poor man's meat" due to its multiple uses. In India, soybean ranked second among various oilseed crops of India and are the important source of our economy contributing five per cent to Gross Net Profit (GNP) [10]. Soybean is the only oilseed crop that produces half of edible oil in whole world. It is grown all over India especially in Madhya Pradesh because it has wide range of adaptable climate to agro-climatic condition & better market value. Being a leguminous crop, it improves soil fertility by fixing atmospheric nitrogen at rate of 65 to 115 kg/ha/year with process of symbiosis through *Rhizobium japonicum*. Soybean crop is rich in high quality protein (40-42%), oil (18 - 20%) and various nutrients like calcium, iron and glycine. Protein content of this crop contains mainly amino acids needed for human nutrition also soybean oil content rates major in unsaturated fatty acids like an oleic and linoleic [2, 3]. The oil contains approx. (0.5-1.0) percent lecithin which is essential for building up of human nerve tissue [2]. It is also good source of isoflavones and therefore it helps in preventing heart diseases, and cancer [6]. At present, India ranks fifth in the area and production in the world after USA, Brazil, Argentina and China [5]. The contribution of India within the world soybean area is 10%, but the contribution to total world soybean grain is merely 4 % indicating the poor levels of productivity in India (1.1 t/ha) as compared to other courtiers (world average 2.2 t/ha) [1].

It is also seen that active nodulation of soybean or any pulse crop stops 45-50 days after sowing and at that time if nutrients are supplied through foliar spray it is found to have beneficial effects on growth,

seed yield and quality parameters [13]. The chemical composition of Soybean and their numerous uses show how soybean production can fulfill the needs of continuous growth of population [12]. Some natural organic liquid formulations like Panchagavya, Beejamrith, Neem leaf Extract and Vermiwash which we can get from plants, cow and vermicomposting units are productive for agricultural and horticultural crop and shows beneficial effect in the term of enhancement of yield and quality of soybean [7]. Highly significant increase in protein content with combination of recommended dose of fertilizer and organic formulations is confirmed by the results recorded by Chaudhary *et al.* [4]. With the introduction of various organic sources in soybean crop production it promotes rapid increase in soybean yield and results on obtaining high quality seeds, which is an alternative method to supply plant nutrition [5, 6].
Neem, often referred to as the "Life-giving tree," "Village pharmacy," "Divine tree," and "Sacred offering of nature," has numerous valuable properties [9, 11].

MATERIAL AND METHODS

Description of study site:

The paper present materials and methodology used in the experiment titled Impact of Liquid Organic Fertilizers with Foliar Application on Growth, Yield and Quality of Soybean with brief description of experiment's site, sampling procedures, soil characterizes, climatic conditions during crop growth, cropping history, *etc.*

The Experiment block of the School of Agricultural Sciences, Shri Guru Ram Rai University (SAS - SGRRU), Pathribagh Dehradun, Uttarakhand, is located in the northwest of the state at an elevation of 450 meters above mean sea level (MSL) and between 29°58' and 31°2'30' North latitude and 77°34'45'' and 78°18'30'' East longitude. The field experiment was carried out during *Kharif* 2023. The average weekly maximum temperature during 2023 varied between 15.2 ºC to 37.8 ºC, respectively. The test site was sandy loam with a pH of 6.5, organic carbon of 0.4%, available nitrogen of 3.52%, available phosphorus of 7.1%, and available potassium of 18.1%. The experiment was laid down in Randomized Block Design consisting of three replications and twelve treatments. *Viz* - T_0 - Control, T_1 - Vermiwash at 10% Foliar Application, T_2 - Beejamrit at 10% Foliar Application, T_3 - Panchgavya at 10% Foliar Application, T_4 - Neem Leaf Extract at 10% Foliar Application, T_5 - Vermiwash at 5% Foliar Application + Beejamrit at 5% Foliar Application, T_6 - Vermiwash at 5% Foliar Application + Panchgavya at 5% Foliar Application, T_7 - Vermiwash at 5% Foliar Application + Neem Leaf Extract at 5% Foliar Application, T_8 - Beejamrit at 5% Foliar Application + Panchgavya at 5% Foliar Application, T_9 - Beejamrit at 5% Foliar Application + Neem Leaf Extract at 5% Foliar Application, T_{10} - Panchgavya at 5% Foliar Application + Neem Leaf Extract at 5% Foliar Application and T_{11} - Vermiwash at 5% Foliar Application + Beejamrit at 5% Foliar Application+ Panchgavya at 5% Foliar Application + Neem Leaf Extract at 5% Foliar Application.

Test of Soybean variety: Pant Soybean - 21 were sown at 30 cm in line apart using a seed rate of 80 Kg/ha in June 29, 2023. The experimental field was ploughed, and then it was properly prepared with the help of a tractor-drawn leveller. During the field preparation, vermicompost, sieved cow dung and different doses of 30 kg N, 60 kg P_2O_5, 30 kg K were provided and then field is covered with ploughed dirt. FYM (0.65% N, 0.25% P, and 0.55% K) was added to the soil and mixed well before sowing. Vermiwash was sprayed at 30–40 DAS, and the seeds were treated with Beejamrit 24 hours prior to planting. Treatments were applied twice by spraying over a standing crop. The first spray was applied at 30 days after sowing, while the second spray was applied 45 days after sowing in field. The positive effects of panchgavya on soybean on growth and production, manifested when it was specifically supplied during the reproductive growth stage rather than vegetative and ripening stages, which exerted a feed-forward effect on photosynthesis coupled with an increased in both stomatal conductances. The crop was manually harvested with a sickle after the grain hardened and reached a moisture level of 12 -15%. The collected material was then sun-dried for three to four days in order to separate the grain from the straw. Data on growth and yield attributes were recorded during the time of crop growth and at the time of harvesting as well. Seed and Straw yield were also recorded during harvest time. Protein and Oil content were determined by standard methods. The data were statistically analysed using standard procedures of ANOVA at 5% level of significance. The approach developed by *Gomez and Gomez* [8] was used to statistically analyze the data by using analysis of variance as applicable RBD.

RESULTS AND DISCUSSION

There is significant difference in all the growth parameters among treatments in 2023 was observed in tables. All treatments showed a significant increment in growth parameters in comparison to control plot. In 2nd year of experimental trial the maximum growth and yield attributing characters were observed and they are respectively as follows **T_{11}** *viz* - Maximum Plant Height (74.46 cm), Number of Branches (8),

Effective Root Nodules (67), Plant Dry Weight (66.53 g), Crop Growth Rate (0.74 g/m^2/day), Relative Growth Rate (0.02 g/g/day) respectively and Yield attributing parameters like Number of Seed per pod (3), Number of Pods per plant (71.667) as well as Seed Yield (594.61 kg/ha), Straw Yield (915.315 kg/ha), Oil Content (19.95%), Protein Content (39.98 %) and Harvest Index (39.39%) respectively followed by **T_8** *viz* - Maximum Plant Height (72.10 cm), Number of Branches (7.33), Effective Root Nodules (65), Plant Dry Weight (66.20 g), Crop Growth Rate (.73 g/m^2/day), Relative Growth Rate (0.02 g/g/day) respectively and Yield attributing parameters like Number of Seed per Pod (3), Number of Pods per plant (69.33) as well as Seed Yield (591.88 kg/ha), Straw Yield (914.14 kg/ha), Oil Content (19.57%), Protein Content (39.92%) and Harvest Index (39.34%) respectively and lowest being recorded in **Control T_0** viz - Minimum Plant Height (57.97 cm), Number of Branches (4.67), Effective Root Nodules (43), Plant Dry Weight (43.88 gm), Crop Growth Rate (.48 g/m^2/day), Relative Growth Rate (0.01 g/g/day) and Yield attributing Parameters like Number of Seed per Pod (3), Number of Pods per Plant (40.66) as well as Seed Yield (422.20 kg/ha), Straw Yield (758.22 kg/ha), Oil Content (17.24 %), Protein Content (37.41 %) and Harvest Index (35.75%).

Table: 1- Impact of Liquid Organic Fertilizers with Foliar Application on Growth attributes of Soybean.

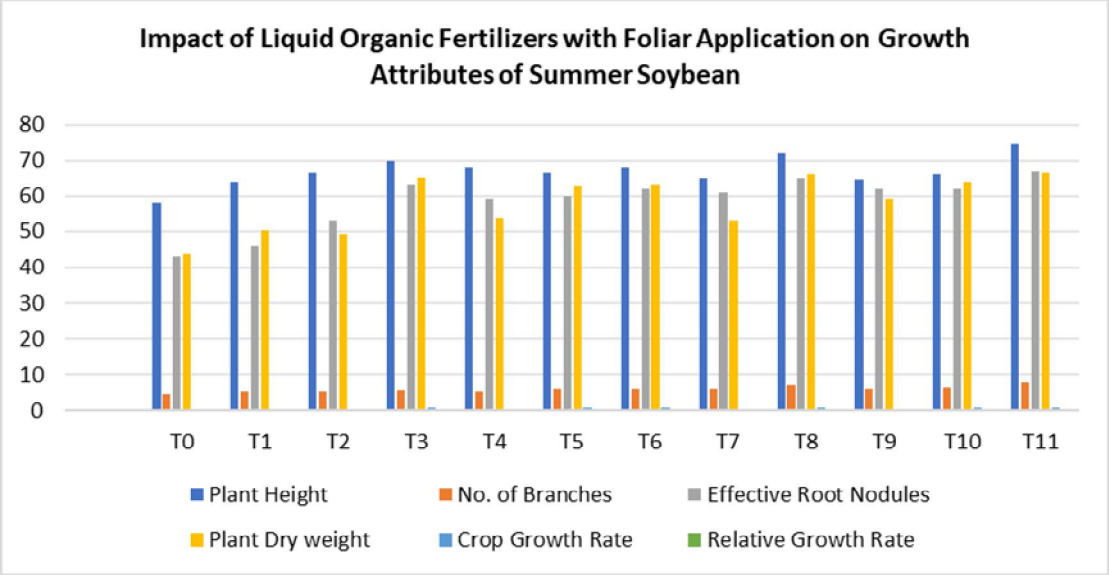
Treatments	**Plant Height (cm)**	**No of Branches /Plant**	**Effective Root Nodules**	**Plant Dry Weight (gm)**	**Crop Growth Rate (g/m^2/day)**	**Relative Growth Rate (g/g/day)**
T_0	57.97	4.67	43	43.88	0.48	0.01
T_1	63.77	5.67	46	50.20	0.55	0.01
T_2	66.65	5.67	53	49.17	0.54	0.01
T_3	69.77	6.00	63	65.11	0.69	0.02
T_4	68.22	5.67	59	53.89	0.59	0.01
T_5	66.52	6.33	60	62.80	0.69	0.01
T_6	67.96	6.33	62	63.02	0.72	0.02
T_7	64.75	6.33	61	52.95	0.58	0.01
T_8	72.10	7.33	65	66.20	0.73	0.02
T_9	64.55	6.33	62	59.16	0.65	0.01
T_{10}	66.21	6.67	62	63.85	0.71	0.02
T_{11}	74.46	8.00	67	66.53	0.74	0.02
C.D.	1.42	0.93	1.13	1.41	0.14	N/A
SE(m)	0.48	0.31	0.38	0.47	0.04	0.002
SE(d)	0.68	0.44	0.54	0.67	0.06	0.003
C.V.	1.25	8.80	1.14	1.42	12.71	18.07

Table: 2- Impact of Liquid Organic Fertilizers with Foliar Application on Yield attributes of Soybean.

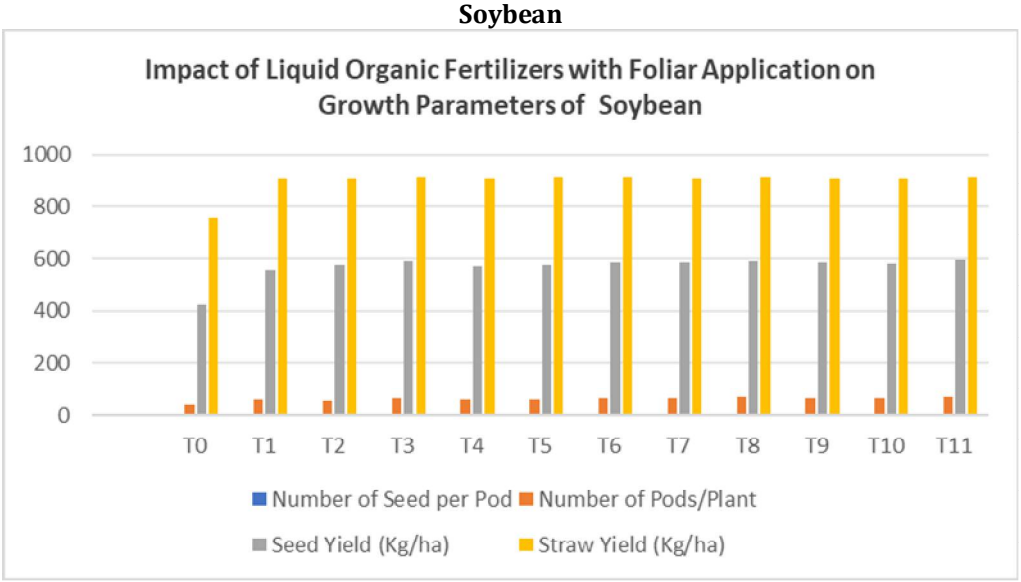
Treatments	**Number of Seed per Pod**	**Number of Pods per Plant**	**Seed Yield (Kg/ha)**	**Straw Yield (Kg / ha)**
T_0	3	40.66	422.20	758.22
T_1	3	57.66	554.44	909.43
T_2	3	56.01	576.16	908.80
T_3	3	66.33	592.01	914.07
T_4	3	58.66	569.30	910.67
T_5	3	58.66	577.51	912.68
T_6	3	63.67	586.11	913.30
T_7	3	62.01	584.77	911.81
T_8	3	69.33	591.88	914.14
T_9	3	66.01	586.76	911.99
T_{10}	3	62.66	580.16	910.89
T_{11}	3	71.66	594.61	915.31
C.D.	N/A	1.46	1.56	1.18
SE (m)	0.09	0.49	0.53	0.40
SE (d)	0.13	0.70	0.75	0.56
C.V.	5.60	1.40	0.16	0.07

Table: 3- Impact of Liquid Organic Fertilizers with Foliar Application on Quality of Soybean.

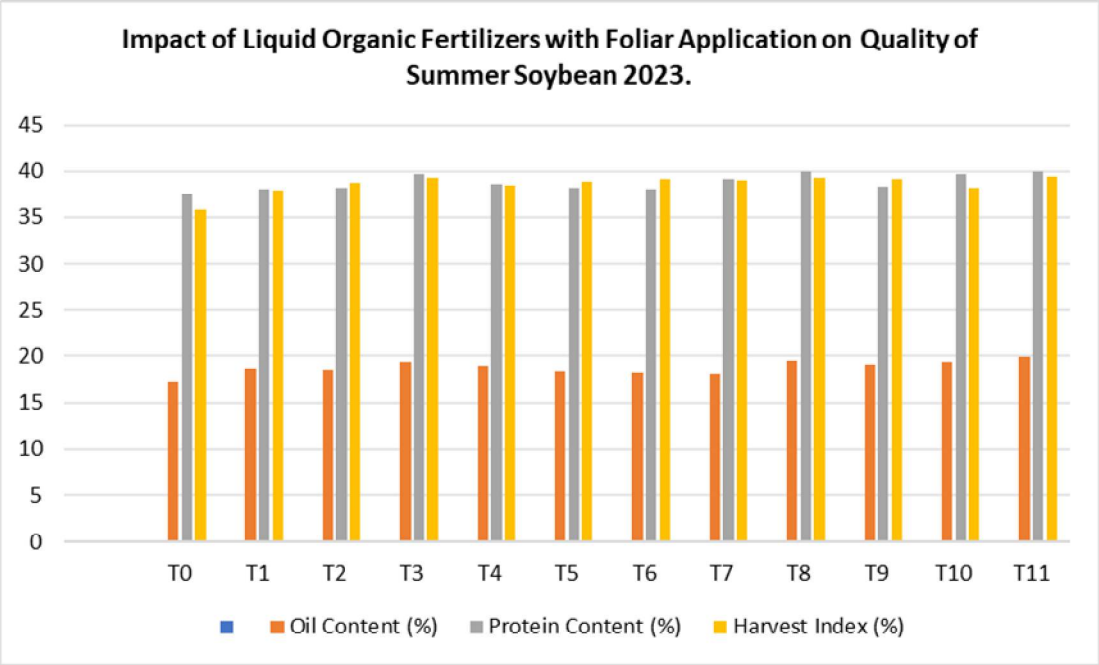
Treatments	Oil Content (%)	Protein Content (%)	Harvest Index (%)
T_0	17.24	37.41	35.75
T_1	18.64	38.02	37.87
T_2	18.60	38.17	38.77
T_3	19.35	39.72	39.31
T_4	18.97	38.56	38.46
T_5	18.41	38.16	38.86
T_6	18.26	38.04	39.07
T_7	18.18	39.11	39.07
T_8	19.55	39.92	39.34
T_9	19.10	38.36	39.15
T_{10}	19.31	39.71	38.16
T_{11}	19.95	39.98	39.39
C.D.	0.41	0.41	0.09
SE (m)	0.14	0.14	0.03
SE (d)	0.19	0.20	0.04
C.V.	1.29	0.63	0.14



Graph 1: Impact of Liquid Organic Fertilizers with Foliar Application on Growth attributes of Soybean



Graph 2: Impact of Liquid Organic Fertilizers with Foliar Application on Yield Parameters of Soybean



Graph 3: Impact of Liquid Organic Fertilizers with Foliar Application on Quality Parameters of Soybean

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