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Effect of *Panchagavya* as Organic Input on Growth, Yield and Economics of Late Sown Rapeseed

Nilakhi Das[1*], Jogesh Goswami[1], Nayan Jyoti Ojha[1], J. C. Das[1], K. N. Das[2] and Hemanta Saikia[3]

[1]Department of Agronomy, [2]Department of Soil science, College of Agriculture, AAU, Jorhat - 785013, India
[3]Department of Agricultural Statistic, College of Sericulture, AAU, Jorhat - 785013, India
**Corresponding author*

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A B S T R A C T

A field experiment was conducted in ICR farm of Assam Agricultural University, Jorhat to evaluate the effect *panchagavya* on growth, yield and economics late sown rapeseed in Assam condition during *rabi* season, 2020-21. The experiment was laid out in Randomised Block Design with three replications and eight treatments like T1: control, T2: RDN through vermicompost (VC), T3: Vedic *panchagavya* soil application (3%), T4: 1 tonne VC/ha as basal + vedic *panchagavya* foliar application (3%), T5: enriched *panchagavya* soil application(3%), T6: enriched *panchagavya* foliar application(3%), T7: vedic *panchagavya* basal application (1.5%) + vedic *panchagavya* foliar application (1.5%), T8: enriched *panchagavya* basal application(1.5%) + enriched *panchagavya* foliar application(1.5%). Results showed that T4 was found to be best among all the treatments regarding growth, yield characteristics, and yield of the late sown rapeseed. The highest values of the growth metrics as well as yield metrics were recorded under treatment T4. This treatment produced the highest seed yield (6.89 q/ha) and stover yield (20.48 q/ha). Likewise, the highest oil yield (258.91 kg/ha) of rapeseed and highest gross return (Rs. 55120/ha) was observed in T4 treatment. But, the maximum net return (Rs. 34020/ha) and B:C ratio (1.90) were recorded under treatment T5.

Introduction

India is the fourth largest producer of rapeseed and mustard in the world. It is generally belong to family *Cruciferae* and it is the third important oilseed crop in the world after soybean and palm oil. Rapeseed was being cultivated in India during 4000 B.C. and later it was spread to China and Japan about 2000 years ago. Among the seven annual edible oilseeds cultivated in India, rapeseed and mustard contribute 24.3 per cent of the total oilseed area and 28.6 per cent of the total oilseed production (Shekhawat *et al.*, 2012). In India, 6.2 to 9.0 mha area is under oilseed production and the production volume of the all oilseeds in the country stood at nearly 37 million metric tonnes and out of that nearly 8 million metric tons was contributed by rapeseed during the year 2019-2020.

In Assam, farmers are mainly opted for solo cropping and grow only one crop in a year or in a season. After the harvest of the rice crop, huge

swaths in rice-growing regions are left fallow. Rice fallow land can be more effectively used for short-term crops like pulses and oilseeds by using the remaining soil moisture and by implementing conservation agriculture techniques. However, growing oilseeds on rice fallow land has a number of challenges, including water scarcity during the post-monsoon season, low temperatures, a short turn-around time after rice harvesting before rapeseed is planted, and a high prevalence of pests and diseases in late-sown crops. Rice fallow of South Asia including India, Bangladesh and Pakistan accounts for 79 per cent (11.65 mha) of the total area (15.0 mha). To exploit these rice fallow areas with oilseeds, location specific and economically viable late sown technologies for better performance are need to be established.

India is rich in different forms of naturally available organic inputs which in turn helps the farmers to adopt organic farming. Since, more than 60 per cent of India's total arable land is under traditional agriculture and it has the potential to become a lead organic food producing country in the world. Therefore, a strong effective national organic policy is needed in current position which will in turn help to give an important place to organic farming (Deshmukh and Barbar, 2015). In recent years, organic farming as a cultivation process is gaining increasing popularity. The popularity of organic products is increasing among the people due to its nutritional properties and health benefits as well as positive impact on environment (Chopra *et al.*, 2013). Northeastern region is already known as organic by default and integrated farming of crop and livestock in rural areas is a common scenario of Assam. Therefore, products derived from cattle makes a good bond with the nature and make the land healthy and fertile. Different organic inputs *viz.*, FYM, compost, cowdung, *panchagavya* etc. may be obtained from such integrated farms which may acts as organic sources of nutrients for sustainable agriculture. *Panchagavya* is an organic product made up of five different cow products *viz.*, cow dung, cow urine, cow milk, cow curd and cow *ghee* (Amalraj *et al.*, 2013). It contains macro and micro nutrients along with various amino acids, growth regulators, vitamins and beneficial microorganism which are responsible to play the role of promoting growth and also provides immunity to plant system (Raghavendra *et al.*, 2014). Therefore, the present experiment was designed to evaluate the effect of *panchagavya* as organic input on growth, yield and economics of late sown rapeseed.

Materials and Methods

An experiment was carried out during *rabi* season of 2020-2021at the organic block of Instructional-cum-Research (ICR) Farm, Assam Agricultural University, Jorhat. The experiment was laid out in Randomized Block Design with eight treatments and three replications. The treatments consisted of T1: control, T2: RDN through vermicompost, T3: vedic *panchagavya* soil application (3%), T4: 1 tonne VC/ha as basal + vedic *panchagavya* foliar application (3%), T5: enriched *panchagavya* soil application (3%), T6: enriched *panchagavya* foliar application (3%), T7: vedic *panchagavya* basal application (1.5%) + vedic *panchagavya* foliar application (1.5%), T8: enriched *panchagavya* basal application (1.5%)+ enriched *panchagavya* foliar application (1.5%). The experimental site was situated in the Upper Brahmaputra Valley Zone of Assam, at altitude of $26^0$44'N, longitude of $94^0$10'E and at an altitude of 87 m above the mean sea level.

The weekly mean bright sunshine hours ranged between 0.9 to 8.8 hours/day. The total amount of rainfall was 68.8 mm which was received in total of seven rainy days. However, there was rainfall of about 19.3 mm before sowing of the crop. The weekly mean evaporation varied from 0.8 to 2.7 mm. The weekly mean maximum temperature varied from 21 to 32.1°C and weekly mean minimum temperature ranged between 8.1 to 17.4°C during the crop growing period. Average relative humidity ranged from 91 to 100% during the morning hours and 42 to 77%in the evening hours. The gross plot size was $20m^2$ (5m x 4m). The recommended spacing the followed was 30cm x10cm.

The field was ploughed thoroughly and leveled and late sown variety of rapeseed *i.e.,* TS-67 was sown in as per the treatment on 9th of December, 2020. Data regarding different growth parameters of the plants were recorded at different interval of time. The plant samples from each plot were collected after harvested and dried under the sun. After drying, the total weight of the seed and stover were measured and noted. The growth and yield analysis for the crop was done through standard formula by using Microsoft Excel.

Vedic *panchagavya*

Panchagavya is mainly a fermented organic formulation made up of cow goods *viz.*, cow dung, cow urine, cow *ghee*, cow milk and cow curd having supportive beneficial microorganisms. In a plastic bucket, fresh cow dung and ghee were combined and kept for three days. On the third day, 10 litres of water were combined with cow milk, cow curd, and cow urine. Then, added that mixture to the cowdung. It was stirred twice a day and left open in the shade upto three weeks. After 3rd week, the mixture was filtered through a cloth or sieve. Filtrate of *panchagavya* was then applied to crops as per treatment (Natarajan, 2002).

Enriched *panchagavya*

In this type of *panchagavya*, along with main five cow goods, sugarcane juice, coconut water and 12-ripe banana were added. Tender coconut water have high amount of auxin, gibberellins and cytokinins which encourage the faster growth of the plants. Fresh cow dung and ghee were initially combined and kept for three days in a plastic bucket. On the third day, 10 litres of water were combined with cow milk, cow curd, and cow urine. Along with this combination, coconut water, sugarcane juice, or jaggery, and 12 ripe bananas was added to the cowdung and left in the shade for fermentation. For three weeks, this solution was adequately stirred in the morning and evening. The enriched *panchagavya* was ready for use after three weeks. Thus, the *panchagavya* produced was filtered before application in the field treatment wise (Natarajan, 2002).

Physical, chemical and microbial properties of *panchagavya*

The sample of *panchagavya* were collected during the time of foliar application and analysed for estimation of N, P, K content and other chemical and biological properties. The pH of the sample was measured using a Glass electrode pH meter (Jackson, 1973). The major nutrients such as nitrogen, phosphorus and potassium present in panchagavya were estimated by following Kjeldahl method (Jackson, 1973), Bray's 1 method (Jackson, 1973), Flame photometric method (Jackson, 1973) respectively. The available organic carbon present in organic liquid manures was estimated using Wet digestion method (Walkey and Black, 1934). The total bacteria, fungi, and other biochemical groups namely, bacteria, fungi, and phosphate-solubilizing bacteria were isolated using the serial dilution and standard plate count method using Nutrient agar (NA), Potato Dextrose Agar (PDA) media. The plates were incubated at 30± 1°C for one and three days and the colony counts were recorded. In terms of colony forming units (cfu) per gm of soil on a dry weight basis, the microbial population was assessed.

Results and Discussion

Physical, chemical and microbial properties of *panchagavya*

The physical, chemical and microbial loads present in *panchagavya* were presented in Table.1. It indicates that the pH of vedic and enriched *panchagavya* recorded were 5.56 and 5.46 respectively. A low pH in *panchagavya* was observed due to presence of different microorganisms mainly lactic acid bacteria which were responsible for production of several organic acids in it during fermentation (Pathak and Ram, 2013). Major nutrients like N, $P_2O_5$and K_2O were recorded (0.06, 0.04 and 0.02 for vedic *panchagavya* and 0.93, 0.08 and 0.43 for enriched *panchagavya*). The microbial population especially bacteria, fungi and phosphate solubilizing bacteria were found in those organic manure solutions of 15 x $10^{9,}$12 x 10^5 and 4.70 x 10^2 cfu/ml in vedic solution and18.6 x

$10^{9,}$16.5 x 10^5 and 5.70 x 10^2 cfu/ml in enriched solution. Naturally occurring beneficial microorganisms, primarily bacteria, yeast, actinomycetes, photosynthetic bacteria, and some fungi, were found in that manure mainly made up of five by product of cow namely cow dung, cow urine, milk, curd and ghee (Swaminanthan, 2007). Girija *et al.,* (2013) also reported that the cow dung contained microorganisms predominantly phyla *bacteroidetes, firmicutes* and *prteobacteria* and members of these phyla considered as efficient degraders of complex organic matter. They have also detected some IAA and siderophore producers and some species having N fixing and phosphate solubilizing activities which in turn help in plant growth. Macro and micro nutrients present in *panchagavya* responsible for promoting growth and also provides immunity to plant system. It also contains various amino acids, growth regulators, vitamins and beneficial microorganisms (Raghavendra *et al.,* 2014).

Effect on growth parameters

Influence of *panchagavya* as organic input on late sown rapeseed and its effect on production were evaluated in this experiment. Different growth parameters like plant height, number of plants/m^2, number of branches/plant, LAI, chlorophyll were recorded at different interval of time. The highest plant height at 60, 90 DAS and at harvest was recorded 52.60, 85.35 and 85.58 cm respectively under treatment 1tonne VC/ ha as basal + vedic *panchagavya* foliar application (3%) which was at par with RDN through VC enriched *panchagavya* foliar application (3%) and over control (43.49 cm). Total number of branches/plant were recorded 8.98 in the plants treated with 1tonne VC/ ha as basal + vedic *panchagavya* foliar application (3%) when compared with control as well as other treatments. The variations in leaf area index at 30, 60, and 90 DAS proved that the effect of *panchagavya* significantly influenced the leaf area index of plants. The LAI was found increased significantly from 30 DAS to 60 DAS but a decreased trend was observed after 60 DAS. Highest LAI was found in the plants treated with 1tonne VC/ ha as basal + vedic *panchagavya* foliar application (3%) *i.e.,* 0.81, 2.22 and 1.10 at 30, 60 and 90 DAS respectively over control and other treatments.

The photosynthetic pigment *i.e.,* chlorophyll content was estimated at 45 DAS recorded 3.71 mg/g in treatment having enriched *panchagavya* soil application (3%) which was highest among all the treatment and control. Present studies revealed that foliar spray of *panchagavya* at 3% along with vermicompost resulted in significant increase in growth attributes. This is in agreement with the finding of Ravusaheb (2008) and Ali *et al.,* (2011). The effects *panchagavya* application on growth parameters may be due to presence of growth enzymes which might have favoured rapid cell division and elongation (Dhasarathan *et al.,* 2018). Similar findings were observed in terms of plant population/ m^2 in *Cassia angustifolia* (Balakumbahan and Rajamani, 2010) and chick pea (Panchal *et al.,* 2017). The results observed under the present investigation were in conformity with the findings of Choudhary *et al.,* (2017); Kumar *et al.,* (2011); Kumawat *et al.,* (2009) and Mudigora and Balikai, (2009) with similar kind of experiments under late sown organic crops.

Effect on crop phenology

The data presented in Table.3 showed that application *panchagavya* foliar application as well as soil application either single or combination with vermicompost did not show any significant result in duration of germination during early stage of the crop. In contrast to that, it showed that the treatment having recommended dose of N through VC recorded took maximum duration (42.64 days) to attain the branching stage which was at par with 1tonne VC/ha as basal + vedic *panchagavya* foliar application (3%), enriched *panchagavya* foliar application (3%), enriched *panchagavya* soil application (1.5%) + enriched *panchagavya* foliar application (1.5%) and vedic *panchagavya* soil application (1.5%) + vedic *panchagavya* foliar application (1.5%) *i.e.,* 40.05, 40.01, 39.24 and 36.39 days respectively over control (21.77 days). The application of recommended dose of N through VC took maximum duration (50.78days) to attain 50

per cent flowering which was statistically at par with 1tonne VC/ha as basal + Vedic *panchagavya* foliar application (3%) and enriched *panchagavya* foliar application (3%) *i.e.,* 50.46 and 49.85 days respectively superior over the minimum duration (37.68 days) took by the control. Significant difference among the treatments and the treatment applying with recommended dose of N through VC was recorded significantly took maximum duration (66.71 days) which was at par with all the remaining treatments except control. However, the maximum duration (92.81days) took to attain maturity stage by the plants were under treatment recommended dose of N through VC which was at par with 1tonne VC/ha as basal + vedic *panchagavya* foliar application (3%), enriched *panchagavya* foliar application (3%), enriched *panchagavya* soil application (1.5%) + enriched *panchagavya* foliar application (1.5%), vedic *panchagavya* soil application (1.5%) + vedic *panchagavya* foliar application (1.5%) and enriched *panchagavya* soil application (3%) *i.e.,* 90.62, 90.16, 89.91, 89.72 and 89.05days respectively. Similar result was also reported by Kumari *et al.,* (2012) under late sown condition. According to Prabhu *et al.,* (2010), *panchagavya* administration could help with early active growth since it would have caused the plant tissue to generate native auxin, enabling it to reach the stage of early active growth. Swain *et al.,* (2015) also reported that application of *panchagavya* as foliar application at three per cent at ten days interval of time produced the maximum plant height, number of flowers and fruits as well as showed early 50 per cent flowering.

Effect on yield attributes and yield

To determine the yield of the this crop, different yield attributes were observed in this present study like number of siliquae/plant, number of seeds/ siliqua, 1000-seeds weight(g), seed yield, stover yield and oil yield obtained have presented in Table.4. Present study indicates that the highest number of siliquae/plant (66.33/plant) were recorded under treatment 1tonne VC/ha as basal + vedic *panchagavya* foliar application (3%) which was statistically at par with the treatment recommended dose of N through VC and enriched *panchagavya* foliar application (3%) *i.e.,* 65.14/plant and 64.44/plant respectively which was superior over control. However, the highest numbers of seeds/siliqua (17.75/siliqua) were recorded under treatment 1tonne VC/ha as basal + vedic *panchagavya* foliar application (3%) which was at par with all the treatments except control (10.95/siliqua). But, in term of 1000-seeds weight, all the treatments were shown almost same results including the control. It might be due to the fact that *panchagavya* promotes development when vermicompost is present which cause the superior results with *panchagavya*. Early growth and development processes were handled by the initial basal application of vermicompost, while the foliar application of *panchagavya* boosted up the growth and development during reproductive periods.

Table.1 The physical, chemical and microbial properties of *panchagavya*

Parameters	Vedic *panchagavya*	Enriched *panchagavya*
pH	5.56	5.46
Available organic carbon	0.76	0.86
Available N	0.06	0.936
Available P_2O_5	0.04	0.081
Available K_2O	0.02	0.435
Bacteria	15×10^9 cfu/ml	18.6×10^9 cfu/ml
Fungi	12×10^5 cfu/ml	16.5×10^5 cfu/ml
Phosphate solubilizing bacteria	4.70×10^2 cfu/ml	5.70×10^2 cfu/ml

Table.2 Effect of *panchagavya* on plant height (cm), number of plants/m^2, number of branches/plant, LAI and chlorophyll content (mg/g) of rapeseed

Treatments	Plant height (cm)			No. of plants/ m^2	No. of branches/plant		LAI			Chlorophyll content (mg/g)
	60DAS	90 DAS	At harvest		Primary	Secondary	30DAS	60DAS	90 DAS	
T_1: Control	43.49	70.25	70.33	49.78	2.09	2.65	0.74	1.35	0.35	3.44
T_2: RDN through vermicompost	52.08	84.43	84.98	72.93	4.43	4.08	0.79	2.13	1.02	3.67
T_3: Vedic *panchagavya* soil application (3%)	45.15	77.03	77.06	53.27	2.73	3.04	0.75	1.57	0.43	3.41
T_4: 1tonne VC/ha as basal + vedic *panchagavya* foliar application (3%)	52.60	85.35	85.58	75.93	4.81	4.17	0.81	2.22	1.10	3.48
T_5: Enriched *panchagavya* soil application (3%)	47.24	77.23	77.77	60.83	3.80	4.29	0.79	1.84	0.67	3.71
T_6: Enriched *panchagavya* foliar application (3%)	51.54	83.38	83.93	69.80	4.60	3.37	0.78	2.18	0.90	3.45
T_7: Vedic *panchagavya* soil application (1.5%)+ vedic *panchagavya* foliar application (1.5%)	49.17	80.13	80.43	57.20	2.34	4.20	0.76	1.90	0.71	3.21
T_8: Enriched *panchagavya* soil application (1.5%) + enriched *panchagavya* foliar application (1.5%)	51.19	81.09	81.12	65.61	4.75	3.71	0.80	2.21	0.87	3.18
S.Em (±)	0.38	0.52	0.83	1.12	0.08	0.10	0.02	0.06	0.03	0.13
$CD_{0.05}$	1.19	1.56	2.51	3.41	0.24	0.29	NS	0.17	0.10	NS

Table.3 Effect of *panchagavya* on emergence and branching, 50 per cent flowering, 50 per cent pod development, and maturity of rapeseed

Treatments	Days to emergence	Days to branching	Days to 50 percent flowering	Days to 50 per cent pod development	Days to maturity
T_1: Control	4.75	21.77	37.68	54.19	84.81
T_2: RDN through vermicompost	4.98	42.64	50.78	66.71	92.81
T_3: Vedic *panchagavya* soil application (3%)	4.99	30.24	40.90	59.31	85.32
T_4: 1tonne VC/ha as basal + vedic *panchagavya* foliar application (3%)	4.89	40.05	50.46	65.04	90.62
T_5: Enriched *panchagavya* soil application (3%)	5.03	28.86	39.59	58.94	89.05
T_6: Enriched *panchagavya* foliar application (3%)	5.01	40.01	49.85	63.47	90.16
T_7: Vedic *panchagavya* soil application (1.5%)+ vedic *panchagavya* foliar application (1.5%)	4.91	36.39	47.24	60.16	89.72
T_8: Enriched *panchagavya* soil application (1.5%) + enriched *panchagavya* foliar application (1.5%)	4.85	39.24	48.38	61.55	89.91
S.Em (±)	0.11	1.17	0.47	0.86	0.80
$CD_{0.05}$	NS	3.55	1.43	2.60	2.42

Fig.1 Seed yield (q/ha) of rapeseed as influenced by different treatments

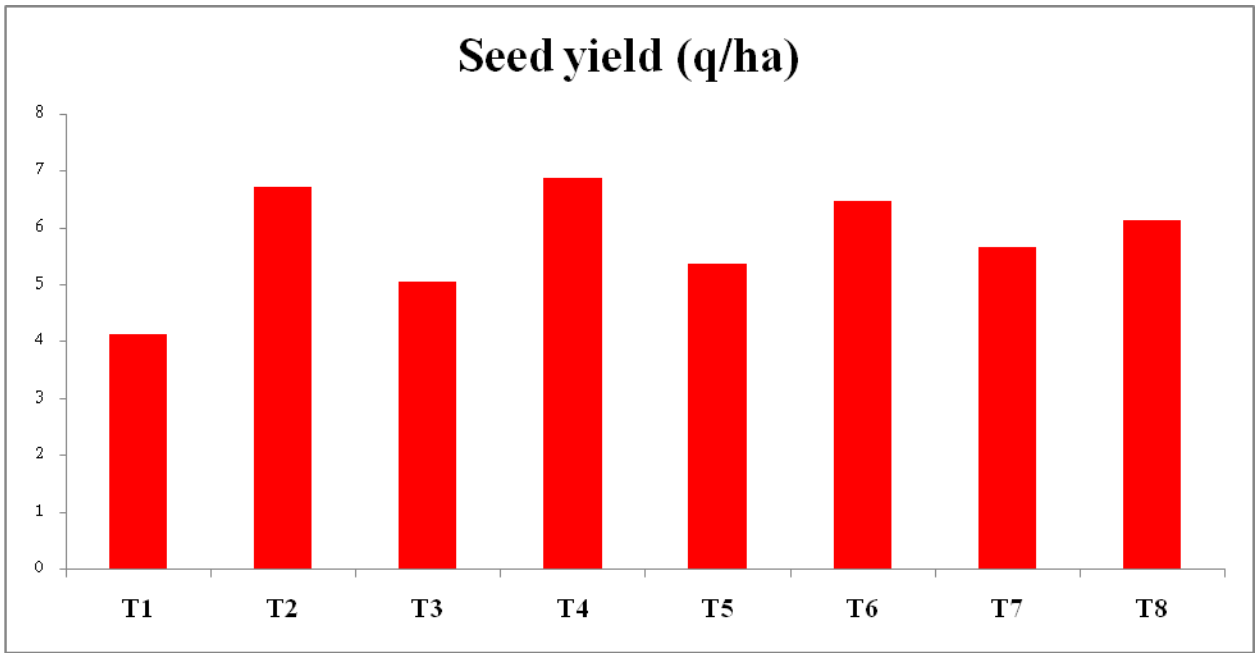


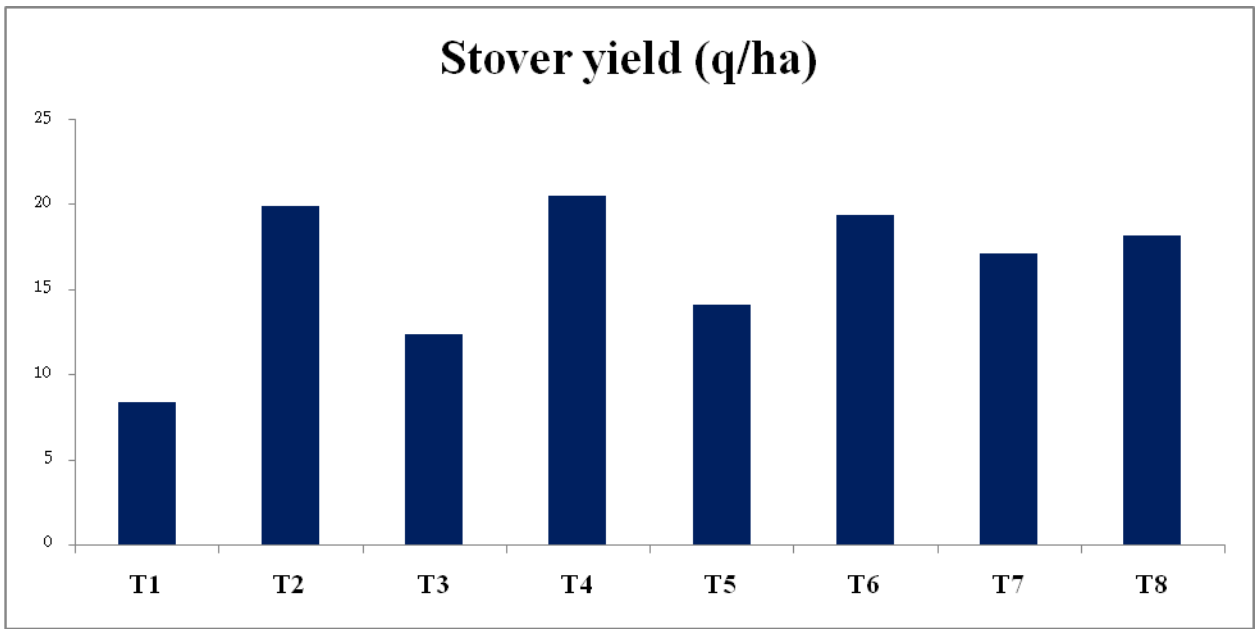
Table.4 Effect of *panchagavya* on number of siliquae/ plant, number of seeds/ siliqua and 1000-seeds weight (g), seed yield (q/ha), stover yield (q/ha) and oil yield (kg/ha) of the plants

Treatments	No. of siliquae/plant	No. of seeds/siliqua	1000-seeds weight(g)	Seed yield (q/ha)	Stover yield (q/ha)	Oil yield (kg/ha)
T_1: Control	54.40	10.95	3.30	4.14	8.35	145.27
T_2: RDN through vermicompost	65.14	17.25	3.34	6.73	19.87	244.02
T_3: Vedic *panchagavya* soil application (3%)	56.22	14.25	3.14	5.24	12.34	188.58
T_4: 1tonne VC/ha as basal + vedic *panchagavya* foliar application (3%)	66.33	17.75	3.72	6.89	20.48	258.91
T_5: Enriched *panchagavya* soil application (3%)	58.15	14.16	3.63	5.39	14.10	197.08
T_6: Enriched *panchagavya* foliar application (3%)	64.44	16.97	3.59	6.48	19.34	247.70
T_7: Vedic *panchagavya* soil application (1.5%)+ vedic *panchagavya* foliar application (1.5%)	60.17	16.58	3.38	5.96	17.41	219.63
T_8: Enriched *panchagavya* soil application (1.5%) + enriched *panchagavya* foliar application (1.5%)	62.02	15.17	3.62	6.16	18.11	227.57
S.Em (±)	0.54	1.04	0.23	0.09	0.24	5.85
$CD_{0.05}$	1.65	3.16	NS	0.27	0.72	17.73

Table.5 Effect of *panchagavya* on economics of rapeseed cultivation under late sown condition

Treatments	Gross return (Rs/ha)	Net return (Rs/ha)	B:C ratio
T_1: Control	33120	17540	1.12
T_2: RDN through vermicompost	53840	22060	0.69
T_3: Vedic *panchagavya* soil application (3%)	41920	24928	1.46
T_4: 1tonne VC/ha as basal + vedic *panchagavya* foliar application (3%)	55120	32128	1.36
T_5: Enriched *panchagavya* soil application (3%)	43120	25800	1.48
T_6: Enriched *panchagavya* foliar application (3%)	51840	34020	1.90
T_7: Vedic *panchagavya* soil application (1.5%) + vedic *panchagavya* foliar application (1.5%)	47680	28776	1.52
T_8: Enriched *panchagavya* soil application (1.5%) + enriched *panchagavya* foliar application (1.5%)	49280	29720	1.51

Fig.2 Stover yield (q/ha) of rapeseed as influenced by different treatments



In foliar spray, nutrients and growth stimulants might be transferred more easily to the various plant portions, which could improve yield qualities. Since, *panchagavya* contains IAA and GA in smaller amounts, foliar spraying of this plant could have stimulated the plant system, increasing the production of a growth regulator in the cell system

The action of the growth regulator in the plant system then assisted in stimulating the necessary growth and development of the plant, which in turn results in better yield attributes. Application of *panchagavya* at branching plus flowering stage may be a good option for late sown crop as observed by Choudhary *et al.,* (2017). Yadav and Tripathi, (2013) reported that application of *panchagavya* with neem leaf extracts in green gram increased the number of pod and also the seeds/ pod, pods/ plant, 1000-seed weight over control. The results observed under the present investigation were in conformity with the findings of Thirumeninathan *et al.,* (2017) and Patel *et al.,* (2013) in cowpea. Table.4 indicates that the highest seed yield (6.89 q/ha) was recorded under the treatment of 1tonne VC/ha as basal + vedic *panchagavya* foliar application (3%) which was at par with recommended dose of N through VC and enriched *panchagavya* foliar application (3%) *i.e.*, 6.73 and 6.48 q/ha respectively when compare to the control.

Similarly, The maximum value of stover yield (20.48 q/ha) was recorded under treatment 1tonne VC/ha as basal + vedic *panchagavya* foliar application (3%) which was at par with treatments applying with recommended dose of N through VC and enriched *panchagavya* foliar application (3%) *i.e.*,19.87 and 19.34 q/ha respectively which were significantly superior to control. Similarly, highest oil yield of rapeseed (258.91kg/ha) was obtained from the treatment applying with1tonne VC/ha as basal + vedic *panchagavya* foliar application (3%) which was at par with enriched *panchagavya* foliar application (3%), recommended dose of N through VC, enriched *panchagavya* soil application (1.5%)+ enriched *panchagavya* foliar application (1.5%) and vedic *panchagavya* soil application which was superior than the control. The availability of various nutrients (N, P, K, S, Zn, Fe, etc.) in *panchagavya* may have contributed to the higher seed and stover yield. Vallimayil and Sekar, (2012) reported that *panchagavya* contains most of the macro and micro nutrients which are responsible to play the role of promoting growth and increase the yield. These nutrients helped to maintain favourable conditions for crop growth and development and made it

simple for plants to absorb the nutrients they needed from the soil, which ultimately resulted in increased yield. Also, combination of *panchagavya* and vermicompost increased the microbial activity of the soil system, which ultimately aided in improving crop nutrition. Because, the vermicompost served as a microbial growth medium for the microorganisms found in *panchagavya*, which may have sped up the system's microbial activity. Similar findings were also observed by Ravi *et al.,* (2012); Natarajan (2002); Patel *et al.,* (2018).

Economics

The economics of various treatment combinations are presented in Table and it indicates that the highest gross return *i.e.,* Rs.55120/ha was obtained under the treatment combination of 1tonne VC/ha as basal + vedic *panchagavya* foliar application (3%). But, highest net return (Rs. 34020/ha) was observed under treatment enriched *panchagavya* foliar application (3%) followed by treatment of1tonne VC/ha as basal + vedic *panchagavya* foliar application (3%) Rs.32128/ha. However, B:C ratio of 1.90 was observed under treatment of enriched *panchagavya* foliar application (3%).That could be as a result of the higher input costs associated with treatment having vedic *panchagavya* foliar application (3%) +1tonne VC/ha, as the base cost of vermicompost is a little higher than the *panchagavya.* Gowthamchand *et al.,* (2019) observed significantly higher B:C ratio in the treatment which received foliar spray of *panchagavya* @ 3% along with *beejamrutha*, *jeevamrutha* and 100% RDN through vermicompost. Results of present study are in conformity with the findings of Rajesh and Kaliyamoorthy, (2013); Boraiah (2013) and Shailaja *et al.,* (2014) that indicated the presence of several advantageous microorganisms that boost the growth and production of the crop by acting as a growth stimulant to the plants, ultimately assisted to offer high B:C ratio. Also, Gopakkali and Sharanappa (2014) reported that significantly higher gross return (Rs.1,51,668), net return (Rs. 96,281) and B:C ratio (2.74) were recorded in Chilli while applying three sprays of *panchagavya* (3%) along with enriched biodigested liquid manure at 125 kg N equivalent/ha.

Thus, it has been established by the current data base on growth, yield attributes, and yield that the yield reduction in rapeseed under late-sown conditions can be minimised by organic nutrition using either vermicompost alone or with vedic and enriched *panchagavya*. From the present experiment, it has been clearly seen that vedic *panchagavya* @ 3% as a foliar application along with 1 tonne of VC/ha as a basal under late seeded conditions was determined to be the best among all the treatments in terms of growth, yield characteristics, and yield of the rapeseed. Approximately 48% more seed yield was produced under this treatment than under the control, which indicates promising prospects for late-sown conditions. Since, there was increase in growth and yield at low concentration of *panchagavya*, it is recommended that *panchagavya* in combination with vermicompost could be economically profitable for cultivation of rapeseed under late sown condition of Assam in organic system of cultivation.

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