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Effect of solid and liquid organic manures on parching sorghum production

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Abstract
A field experiment was conducted to study effect of solid and liquid organic manures on the parching sorghum during rabi, 2020 at Instructional farm, College of Agriculture, Vijayapur. The experiment was laid out under randomized complete block design with 9 treatments replicated thrice using SMJ-1 variety of parching sorghum. Application of ghanajeevamrutha based on 100% RDN as basal dose coupled with foliar application of 25 percent jeevamrutha at 20 and 45 DAS recorded significantly higher roasted panicle weight per plant (60.99g), roasted grain yield (1505 kg ha^{-1}), green fodder yield (4720 kg ha^{-1}) and dry fodder yield (3318 kg ha^{-1}) compared to other treatments. In addition to improvement in the availability of major nutrients and plant nutrient uptake were recorded with incorporation of ghanajeevamrutha or vermicompost along with the liquid organic manure.

Keywords: Ghanajeevamrutha, hurda, Jeevamrutha, parching sorghum, vermiwash

Introduction
Sorghum [*Sorghum bicolor* (L.) Moench] is also known as "Jowar" belongs to grass poaceae family. Sorghum is essential seasonal crop as well as stand fifth number all over the world out of major resources of foods like wheat and maize. Generally, sorghum is cultivated in nutrient-poor soils in frequently drought-prone areas, it offers food and fodder security through risk aversion on sustainable basis. The tender jowar grains in English is called as parching Sorghum, also known by different names such as sheetani (Kannada), hurda (Marathi) and ponk (Gujarati). Basically, the period during late winter when sorghum grain is juicy and very tender, panicle is roasted over cakes of dried cow dung. It is the main staple grain of rural Maharashtra and Northern Karnataka. American chefs say that sweet grain sorghum is the next "wonder grain". They extoll its health benefits, its versatility in cooking (among other things, it pops like corn) and its eco-friendliness due to being exceptionally drought-tolerant (Bagchi, 2013) [1]. Various important antioxidants are possessed in the bran layer of the hurda sorghum. These antioxidants reduce the risk of esophageal cancer (Joseph *et al*., 2005) [5].
If we discuss about organic manures, they are basically composed of waste and residues parts from plants and animals (Elawad, 2004) [2]. Therefore, the use of locally available agro-inputs in agriculture by avoiding or minimizing the use of synthetically compounded agro-chemicals appears to be one of the profitable options to sustain the agricultural productivity by maintaining the soil fertility without affecting its physical property. In this context a field experiment was planned to produce parching sorghum organically to determine the effect of organic manures on yield, soil properties and nutrient uptake of parching sorghum.

Material and Methods
The experiment was conducted at College of Agriculture, Vijayapur, situated in the Northern Dry Zone of Karnataka (Zone 3), at 16^0 49' North latitude, 75^0 43' East longitude and at an altitude of 593.8 m above the mean sea level. The soil was low in organic carbon (0.37%), low in available nitrogen (188 kg ha^{-1}), high in both available phosphorus (29.5 kg ha^{-1}) and available potassium (390 kg ha^{-1} high). During the cropping period of 2020-21, a total rainfall of 865.5 mm was received in 51 rainy days from April 2020 to March 2021 as against the normal rain of 594.4 mm which was received in 38 rainy days. The maximum monthly temperature over the years (1981-2019) was the highest in the month of May (39.6 °C), while it was the lowest in the month of December (29.1 °C). The normal monthly mean minimum temperature was the lowest in the month of January (14.6 °C) (Figure 1).
The field experiment was laid out in Randomized Complete Block Design with 9 treatments (T_1-Ghanajeevamrutha based on 100% RDN as basal dose, T_2-Vermicompost based on 100%

RDN as basal dose, T_3- T_1 + foliar application of 10% vermiwash at 20 & 45 DAS, T_4- T_1 + foliar application of 10% cow urine at 20 & 45 DAS, T_5- T_1 + foliar application of 25% jeevamrutha at 20 & 45 DAS, T_6- T_2 + foliar application of 10% vermiwash at 20 & 45 DAS, T_7- T_2 + foliar application of 10% cow urine at 20 & 45 DAS, T_8- T_2 + foliar application of 25% jeevamrutha at 20 & 45 DAS and T_9- Organic RPP of *parching* sorghum) and 3 replications.

After the previous crop was harvested, the ground was ploughed once again and planking was done in both the direction to prepare a levelled and fine seed bed. The total quantity of ghanajeevamrutha and vermicompost were calculated based on their respective nitrogen content in order to meet the recommended dose of N (40 kg ha^{-1}). The variety SMJ-1 was used after treatment with biofertilizers and dried under the shade. Sowing was done on 20th October with the spacing of 45×15 cm. Intercultivation was done to remove all weeds from the field in order to check crop weed competition. Observation on growth attributes were taken on 30, 60 days after sowing and at harvest. Harvesting was done when crop had attained milky dough stage. The sorghum heads from net plot were cut, panicles were subjected for baking in cow dung fire for 5 min. Then the roasted sorghum grains were separated by hand by holding the panicle in both the hands and then rubbing it with palm. The raw and roasted grains were weighed. The stalks were separately weighed after drying which is useful green fodder for cattle. Using the formula suggested by Donald (1962) [3], the ratio of economic yield to biological yield was computed. The yield attributes and yield observations were recorded from the net plots and grain yield was converted to hectare basis in kilograms. Available N of composite soil samples after harvest was measured by using the Alkaline permanganate method (Subbaih and Asija, 1956) [12], available P_2O_5 by using Olsen's method (Olsen *et al*., 1954) [9] and available K_2O by using the Flame photometric method (Jackson, 1973) [4] and nutrient uptake by both grains and straw were also computed using formula.

$$\text{Nutrient uptake (kg ha}^{-1}) = \frac{\text{Nutrient content (\%) x Grain or fodder yield (kg ha}^{-1})}{100}$$

The data collected from the experiment at different growth stages and at harvest were subjected to statistical analysis as described by Gomez and Gomez (1984) [6]. The level of significance used for 'F' and 't' tests was P=0.05. Critical Difference (CD) values were calculated at 5 percent probability level if the F test was found to be significant.

Results and Discussion

Effect of solid and liquid organic manures on grain yield and fodder yield of parching sorghum

Raw panicle weight and roasted panicle weight of *parching* sorghum differed significantly with incorporation of ghanajeevamrutha based on 100 percent RDN as basal dose coupled with foliar application of 25 percent jeevamrutha at 20 & 45 DAS (88.74 g and 77.79 g respectively). Increase in raw grain yield, roasted grain weight, green fodder yield and dry fodder yield was noticed with infusion of ghanajeevamrutha based on 100 percent RDN as basal dose plus foliar application of 25 percent jeevamrutha at 20 & 45 DAS (1063 kg ha^{-1}, 1505 kg ha^{-1}, 5932 kg ha^{-1} and 3318 kg ha^{-1} respectively) over other treatments (Table 1).

This increment in grain and fodder yield was mainly due to inclusion of organic manures as well as jeevamrutha as a foliar spray which improved the soil health, so that plants got benefited with the balanced level of nutrition which led to higher yield. Significant enhancement in the growth and yield parameters of foxtail millet can be seen on application of jeevamrutha + mulching + compost + vermicompost + panchagavya treatment over control as reported by Upendranaik *et al*. (2018) [13] which is in conformity to the similar findings of Kumbar and Devakumar (2014) [7].

Effect of solid and liquid organic manures on availability of major nutrients

The results pertaining to available nitrogen were significantly higher with infusion of ghanajeevamrutha based on 100 percent RDN as basal dose plus foliar application of 25 percent jeevamrutha at 20 & 45 DAS (205.65 kg ha^{-1}) compared to other treatments. With respect to phosphorus and potassium it was higher with the application of vermicompost based on 100 percent RDN as basal dose plus foliar application of 25 percent jeevamrutha at 20 & 45 DAS (33.98 kg ha^{-1} and 448.30 kg ha^{-1} respectively) compared to other treatments (Table 2).

This may be due to mineralization of nitrogen from ghanajeevamrutha helped increased availability of nitrogen. Organic acids released during decomposition of organics helped in solubilization of phosphorus. Due to increased CEC of the soil because of infusion of vermicompost resulted in higher available K. Also due to more supply of phosphorus and potassium through vermicompost incorporation than the recommended doses increased the availability of both the nutrients. These results are in conformity to the reports of Meena and Ram (2016) [8] and Reshma *et al.* (2019) [10].

Effect of solid and liquid organic manures on plant nutrient uptake

Significantly higher uptake of N by grains and fodder was observed with incorporation of ghanajeevamrutha based on 100 percent RDN as basal dose plus foliar application of 25 percent jeevamrutha at 20 & 45 DAS (47.72 kg ha^{-1} and 37.76 kg ha^{-1} respectively), uptake of P_2O_5 by grains and fodder was higher with vermicompost based on 100 percent RDN as basal dose coupled with foliar application of 25 percent jeevamrutha at 20 & 45 DAS (6.84 kg ha^{-1} and 15.74 kg ha^{-1} respectively), whereas higher uptake of K_2O was observed with vermicompost based on 100 percent RDN as basal dose plus foliar application of 10 percent cow urine at 20 & 45 DAS (32.75 kg ha^{-1} and 81.07 kg ha^{-1} respectively) (Figure 2).

This increment observed in uptake was mainly because of combined application of organic manures along with liquid organic manures which helped in enhancement of available nutrient status of the soil there by support the root for better uptake of nutrients. There is a slow and steady rate of nutrients release pattern which was observed in incubation study might be another reason for higher uptake of nutrients by the crop. These outcomes are in agreement with the findings of Shete *et al.* (2011) [11] who revealed that total nitrogen and phosphorus uptake in greengram was directly proportional to the application of FYM at 5 t ha^{-1}.

Table 1: Panicle weight, grain and fodder yield of *parching* sorghum as influenced by different organic sources

Treatments	Panicle weight per plant (g)		Grain yield (kg ha^{-1})		Fodder yield (kg ha^{-1})		HI (%)
	Raw	Roasted	Raw	Roasted	Green fodder yield	Dry fodder yield	
T_1: Ghanajeevamrutha based on 100% RDN as basal dose	70.34	60.06	819	1220	4212	2104	16.38
T_2: Vermicompost based on 100% RDN as basal dose	69.60	58.18	804	1209	4173	2016	16.33
T_3: T_1 + foliar application of 10% vermiwash at 20 & 45 DAS	77.27	63.80	907	1314	4865	2534	15.73
T_4: T_1 + foliar application 10% cow urine at 20 & 45 DAS	80.53	67.72	936	1359	5113	2860	15.45
T_5: T_1 + foliar application 25% jeevamrutha at 20 & 45 DAS	88.74	77.79	1063	1505	5932	3318	15.27
T_6: T_2 + foliar application 10% vermiwash at 20 & 45 DAS	75.03	60.99	884	1299	4720	2445	15.77
T_7: T_2 + foliar application 10% cow urine at 20 & 45 DAS	79.00	66.89	924	1344	5038	2787	15.52
T_8: T_2 + foliar application 25% jeevamrutha at 20 & 45 DAS	87.67	76.30	1045	1485	5822	3249	15.26
T_9: Organic RPP of *parching* sorghum	72.40	58.42	853	1266	4518	2332	15.99
SEm±	3.45	3.79	42	63	254	122	1.02
CD (P=0.05)	10.35	11.35	127	188	764	366	NS

Note: RDN- Recommended dose of Nitrogen DAS- days after sowing
RPP- Recommended package of practices NS- Non-significant

Table 2: Available N, P_2O_5 and K_2O after harvest of *parching* sorghum as influenced by different organic sources

Treatments	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
T_1: Ghanajeevamrutha based on 100% RDN as basal dose	200.76	22.24	394.39
T_2: Vermicompost based on 100% RDN as basal dose	189.07	32.86	436.55
T_3: T_1 + foliar application of 10% vermiwash at 20 & 45 DAS	202.01	23.68	404.70
T_4: T_1 + foliar application 10% cow urine at 20 & 45 DAS	204.24	23.36	398.50
T_5: T_1 + foliar application 25% jeevamrutha at 20 & 45 DAS	205.65	23.98	403.91
T_6: T_2 + foliar application 10% vermiwash at 20 & 45 DAS	191.60	32.97	437.22
T_7: T_2 + foliar application 10% cow urine at 20 & 45 DAS	195.81	33.59	442.17
T_8: T_2 + foliar application 25% jeevamrutha at 20 & 45 DAS	197.04	33.98	448.30
T_9: Organic RPP of *parching* sorghum	189.75	32.06	420.77
SEm±	3.71	1.39	11.88
CD (p=0.05)	11.12	4.16	35.6

Note: RDN- Recommended dose of Nitrogen DAS- days after sowing
RPP- Recommended package of practices NS- Non-significant

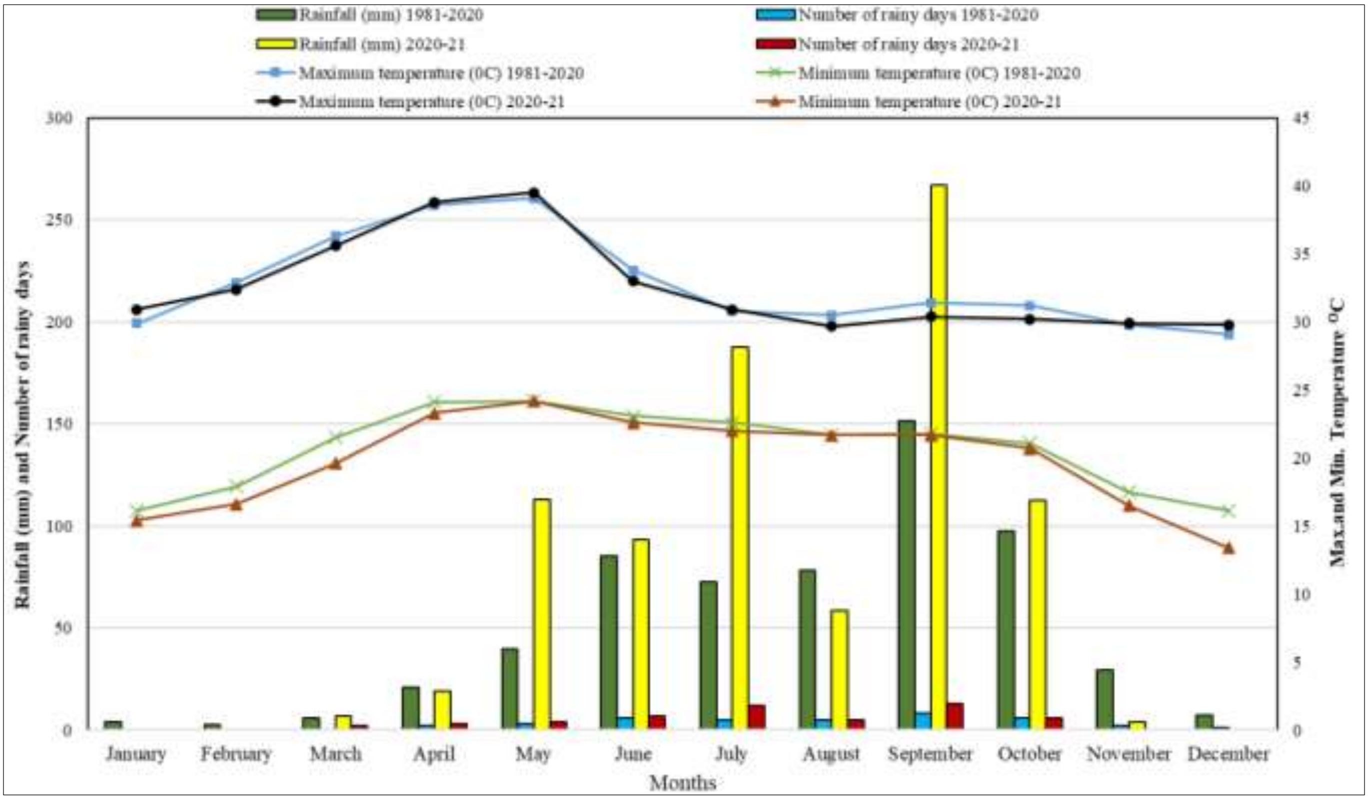

Fig 1: Monthly meteorological data for experimental year (2020-21) against average monthly meteorological data for 39 years (1981-2020) at RARS, Vijayapura (Karnataka)

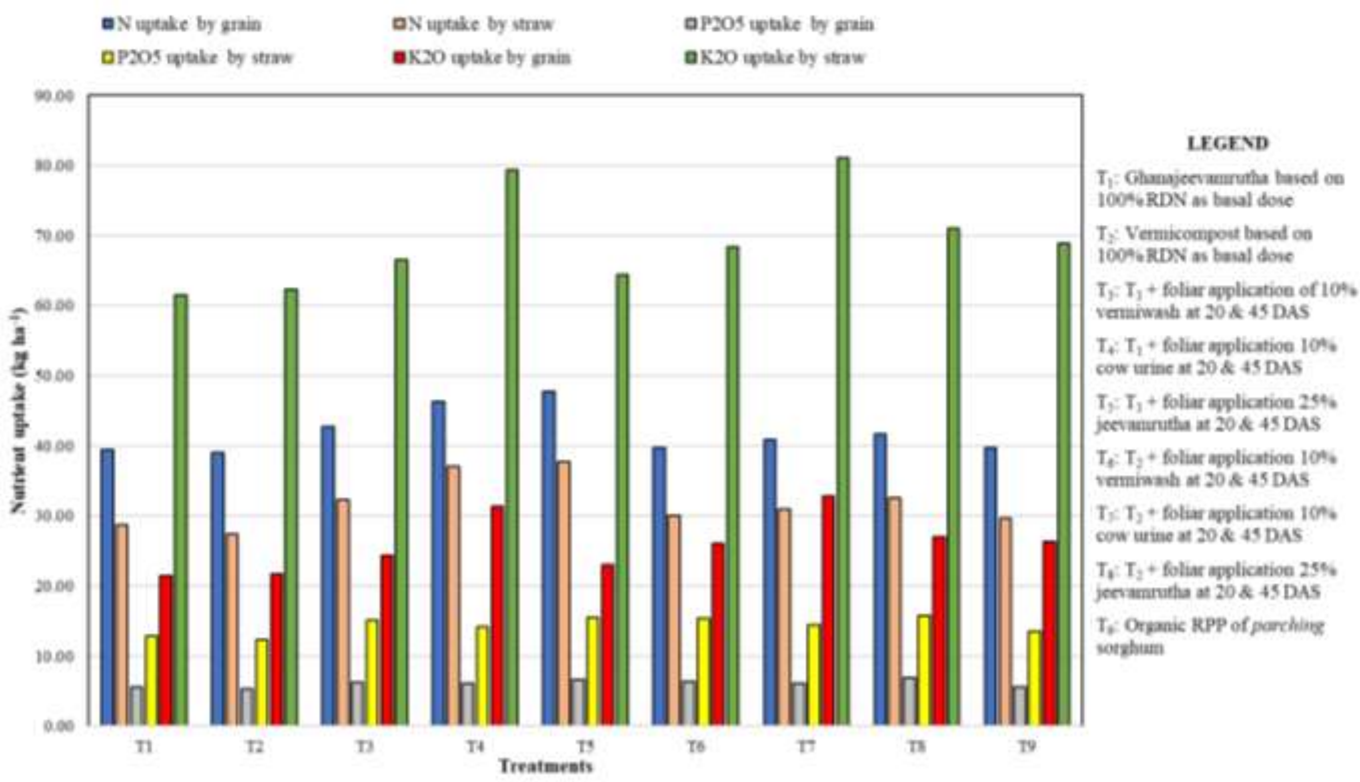

Fig 2: N, P_2O_5 and K_2O uptake of *parching* sorghum as influenced by different organic sources

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