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Response of summer pearl millet [*Pennisetum glaucum* (L.) R. Br. Emend. Stuntz] to various bio-enhancers under organic farming

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Abstract

In a study titled "Response of summer pearl millet [*Pennisetum glaucum* (L.) R. Br. Emend. Stuntz] to various bio-enhancers under organic farming," ten treatments were applied in a randomized block design with three replications in the summer months of 2021 and 2022 on medium black calcareous soil in Junagadh, Gujarat. The application of *Panchgavya* @ 3% foliar spray at 30, 45 and 60 DAS was found to be superior in terms of growth attributes, yield attributes and yield viz., plant height at 30 DAS, 60 DAS and at harvest, number of total tillers per plant, number of effective tillers per plant, earhead length, earhead girth, grain weight/earhead, test weight, grain yield, stover yield and harvest index, subsequently Banana sap @ 1% foliar spray at 30, 45 and 60 DAS.

Keywords: Pearl millet, *Panchgavya*, banana sap, bio-enhancer, organic farming

Introduction

The most common variety of millet farmed is pearl millet. Since ancient times, it has been grown throughout Africa and the Indian subcontinent. After rice, wheat, maize and sorghum, pearl millet ranks fifth in importance among cereal crops worldwide. It is also the fourth most extensively grown food crop in India. It is beneficial for diabetics and has greater fiber. Compared to wheat and rice, it is the least expensive grain and has the highest nutritional content, particularly in iron, calcium, and zinc.

Acknowledging the detrimental effects of excessive chemical use on the environment, human health, and soil health, the Indian government is supporting organic farming through a number of programs and initiatives. In 2000, the Indian government established the National Agriculture Policy, which recognized organic farming as a specific category of farming. The Gujarat government has announced the "Gujarat Organic Farming Policy-2015," which aims to promote the use of scientifically advanced organic farming methods for a sustainable agricultural system, as well as reliable food supply chain and marketing (OFAI, 2015) [10]. In order to effectively implement the policy, a composite package of practices for the major crops in the region must be developed. Several bio-enhancers, such as *Panchgavya*, Banana sap, Sea weed extract, *Jivamrut*, *Go-Krupa Amrutam*, *Amrut Pani*, Vermiwash, cow urine etc., have been developed in different organic farming systems by creative organic growers/associations and NGOs. The policy's goal is to promote technically sound, environmentally non-degrading, economically viable, and socially acceptable use of natural resources in favor of organic agriculture. (Gupta *et al.*, 2017) [1].

Materials and Methods

During the summer of 2021 and 2022, a field experiment was carried out at the Organic Farming Research Farm, which is part of the Department of Agronomy at the College of Agriculture in Junagadh, Gujarat. Geographically, Junagadh is located 60 meters above mean sea level in latitude 21.5 degrees North and longitude 70.5 degrees East. The experimental plot's soil had a clayey texture and an alkaline reaction (pH 8.0 and 7.8, EC 0.56 and 0.52 dS/m during 2021 and 2022 respectively) having available nitrogen (277 and 288 kg/ha during 2021 and 2022 respectively), available phosphorus (25.35 and 26.86 kg/ha during 2021 and 2022 respectively) and available potash (251 and 249 kg/ha during 2021 and 2022 respectively). The mean maximum temperature (34.7 to 47.3 °C and 34.6 to 48.0 °C during 2021 and 2022 respectively) and minimum temperature (20.5 to 33.6 °C and 22.0 to 34.1 °C during 2021 and 2022 respectively), wind speed (3.4-10.3 and 4.1-11.8 km/h during 2021 and

2022 respectively), bright sun shine (3.4-10.3 and 4.0-11.0 h during 2021 and 2022 respectively) and daily evaporation (4.6 – 9.3 and 4.8 to 10.8 mm during 2021 and 2022 respectively) were observed and remained favourable for the crop. There were ten treatments in the trial viz., T₁: *Panchgavya* @ 3% foliar spray at 30, 45 and 60 DAS, T₂: Banana sap @ 1% foliar spray at 30, 45 and 60 DAS, T₃: Sea weed extract @ 3.5% foliar spray at 30, 45 and 60 DAS, T₄: Humic acid @ 20 kg/ha as soil application at sowing, T₅: Vermiwash 12.5 L/ha + Cow urine 12.5 L/ha as foliar spray at 30, 45 and 60 DAS, T₆: *Jivamrut* @ 500 L/ha with irrigation at sowing, 30 to 40 and 50 to 60 DAS, T₇: *Go-Krupa Amrutam* @ 2500 L/ha with irrigation at sowing, 30 to 40 and 50 to 60 DAS, T₈: *Amrut Pani* @ 500 L/ha with irrigation at sowing, 30 to 40 and 50 to 60 DAS, T₉: Cow urine @ 500 L/ha with irrigation at sowing, 30 to 40 and 50 to 60 DAS and T₁₀: Control was laid out in randomized block design with three replications. FYM 10 t/ha is commonly applied at sowing. The dimensions of the gross and net plots were 5.0 x 3.6 m² and 4.0 x 2.4 m², in that order. Using a seed rate of 4 kg/ha, the pearl millet variety “GHB 1129” was sown in March at a 60 cm spacing. The intrarow spacing was maintained by thinning. The National Centre for Organic Farming, Ghaziabad, provided guidelines on how to prepare the cow-based formulations on the farm (NCOF, 2006) [9].

Results and Discussion

Effect on growth attributes

The Significantly higher values of the plant height at 30 DAS (42.63 cm), 60 DAS (147.81 cm) and at harvest (183.23 cm) and number of total tillers per plant (35.13) were noted when the treatment of *Panchgavya* @ 3% foliar spray at 30, 45 and 60 DAS (T₁), which were at par with Banana sap @ 1% foliar spray at 30, 45 and 60 DAS (T₂), Sea weed extract @ 3.5% foliar spray at 30, 45 and 60 DAS (T₃) and *Jivamrut* @ 500 L ha⁻¹ with irrigation at sowing, 30 to 40 and 50 to 60 DAS (T₆) in most of the treatments. However, the Control (T₁₀) treatment showed the lowest values of these growth attributes. Higher plant heights at 30 DAS, 60 DAS and at harvest and number of total tillers per plant were observed with the treatment of *Panchgavya* @ 3% foliar spray at 30, 45 and 60 DAS (T₁), followed by Banana sap @ 1% foliar spray at 30, 45 and 60 DAS (T₂). *Panchgavya* (fermented liquid organic manure) has a high microbial load, meaning that it contains both methylotrophic profile bacteria and effective microorganisms, which would have enhanced the production of phytohormones like auxins and gibberellins. The application of nutrients through foliar spraying *Panchgavya*

may have contributed to the increase in plant height because it contains a favourable combination of macro and micronutrients, growth hormones, and biofertilizers in a liquid formulation. Additionally, the presence of growth enzymes in *Panchgavya* may have encouraged rapid cell division and elongation and increased the activities of beneficial microorganisms in soil by applying FYM, which in turn led to the production of substances that promote growth and improves nutrient availability. Similar findings have been reported by Shwetha (2008) [15], Kasbe *et al.* (2009) [3], Kumar *et al.* (2011) [4] and Sahare (2015) [13].

Effect on yield attributes and yields

The treatment *Panchgavya* @ 3% foliar spray at 30, 45 and 60 DAS (T₁) superior yield parameters viz. number of effective tillers per plant (4.63), earhead length (24.57 cm), earhead girth (8.72 cm), grain weight per earhead (35.13 g), test weight (8.74 g), grain yield (5290 kg/ha), stover yield (9197 kg/ha) and harvest index (18.24) followed by Banana sap @ 1% foliar spray at 30, 45 and 60 DAS (T₂), Sea weed extract @ 3.5% foliar spray at 30, 45 and 60 DAS (T₃) and *Jivamrut* @ 500 L ha⁻¹ with irrigation at sowing, 30 to 40 and 50 to 60 DAS (T₆). Nonetheless, the control treatment had the notably lowest levels of these yield attributes (T₁₀). The previous section highlighted that *panchgavya*'s enhanced photosynthetic efficiency led to a notable improvement in the crop's overall development, as measured by plant height and the number of effective tillers per plant.

When used as a foliar spray, the amounts of IAA and GA in *panchgavya* may have accelerated the length of the earhead, resulting in maximum grain setting. It may have facilitated the rapid and optimal intake of nutrients, causing the vegetative phase to give way to the reproductive phase. In order to produce growth-promoting substances and improve nutrient availability for a longer period of time, FYM may have enhanced the biochemical properties of the soil and increased the activities of beneficial microorganisms. These improvements may have had a positive impact on the growth and yield parameters of pearl millet. Grain and stover yields were raised as a result of the improved source-sink connection brought about by the overall improvement in crop growth. The present findings are in accordance with those earlier reported by Yadav and Christopher (2006) [19], Ravichandran *et al.* (2011) [11], Mishra *et al.* (2015) [7], Singhal *et al.* (2015) [16], Mavarkar *et al.* (2016) [6], Sadhukhan *et al.* (2018) [12], Usadadia *et al.* (2019) [18], Teli *et al.* (2020) [17], Sarita *et al.* (2021) [14], Javiya *et al.* (2022) [2], Malaviya (2022) [5] and Nagar *et al.* (2022) [8].

Table 1: Effect of different treatments on growth attributes of pearl millet. (Pooled over two years)

| Treatments | Plant height (cm) | | | Number of total tillers/plant |
|---|-------------------|--------|---------|-------------------------------|
| | 30 DAS | 60 DAS | Harvest | |
| T ₁ : <i>Panchgavya</i> @ 3% foliar spray at 30, 45 and 60 DAS | 36.60 | 147.81 | 183.23 | 6.63 |
| T ₂ : Banana sap @ 1% foliar spray at 30, 45 and 60 DAS | 35.50 | 145.62 | 178.77 | 6.24 |
| T ₃ : Sea weed extract @ 3.5% foliar spray at 30, 45 and 60 DAS | 34.18 | 143.30 | 177.42 | 6.00 |
| T ₄ : Humic acid @ 20 kg/ha as soil application at sowing | 39.19 | 133.05 | 162.68 | 5.68 |
| T ₅ : Vermiwash 12.5 L/ha + cow urine 12.5 L/ha as foliar spray at 30, 45 and 60 DAS | 33.90 | 131.72 | 160.86 | 5.51 |
| T ₆ : <i>Jivamrut</i> @ 500 L/ha with irrigation at sowing, 30 to 40 and 50 to 60 DAS | 42.63 | 139.88 | 174.40 | 5.97 |
| T ₇ : <i>Go-Krupa Amrutam</i> @ 2500 L/ha with irrigation at sowing, 30 to 40 and 50 to 60 DAS | 41.29 | 138.49 | 169.22 | 5.90 |
| T ₈ : <i>Amrut Pani</i> @ 500 L/ha with irrigation at sowing, 30 to 40 and 50 to 60 DAS | 40.25 | 134.02 | 164.74 | 5.72 |
| T ₉ : Cow urine @ 500 L/ha with irrigation at sowing, 30 to 40 and 50 to 60 DAS | 32.23 | 129.60 | 154.00 | 4.99 |
| T ₁₀ : Control | 30.05 | 125.73 | 147.00 | 4.39 |
| S.Em.± | 1.43 | 3.28 | 4.14 | 0.17 |
| C.D. at 5% | 4.09 | 9.39 | 11.88 | 0.49 |
| C.V.% | 9.55 | 5.86 | 6.06 | 7.29 |

Table 2: Effect of different treatments on yield and yield attributes of pearl millet (Pooled over two years)

| Treatments | No. of effective tillers/plant | Earhead length (cm) | Earhead girth (cm) | Grain weight/earhead (g) | Test weight (g) | Grain yield (kg/ha) | Stover yield (kg/ha) | Harvest index (%) |
|---|--------------------------------|---------------------|--------------------|--------------------------|-----------------|---------------------|----------------------|-------------------|
| T ₁ : <i>Panchgavya</i> @ 3% foliar spray at 30, 45 and 60 DAS | 4.63 | 24.57 | 8.72 | 35.13 | 8.74 | 5290 | 9197 | 18.24 |
| T ₂ : Banana sap @ 1% foliar spray at 30, 45 and 60 DAS | 4.24 | 24.07 | 8.62 | 34.03 | 8.64 | 5092 | 9127 | 18.01 |
| T ₃ : Sea weed extract @ 3.5% foliar spray at 30, 45 and 60 DAS | 4.21 | 23.40 | 8.33 | 32.60 | 8.30 | 4397 | 8461 | 18.78 |
| T ₄ : Humic acid @ 20 kg/ha as soil application at sowing | 3.67 | 21.26 | 6.99 | 28.66 | 6.37 | 3736 | 6876 | 17.32 |
| T ₅ : Vermiwash 12.5 L/ha + cow urine 12.5 L/ha as foliar spray at 30, 45 and 60 DAS | 3.52 | 20.96 | 6.68 | 28.03 | 5.99 | 3600 | 6784 | 17.61 |
| T ₆ : <i>Jivamrut</i> @ 500 L/ha with irrigation at sowing, 30 to 40 and 50 to 60 DAS | 4.09 | 23.14 | 8.05 | 31.87 | 7.87 | 4243 | 8038 | 18.86 |
| T ₇ : <i>Go-Krupa Amrutam</i> @ 2500 L/ha with irrigation at sowing, 30 to 40 and 50 to 60 DAS | 3.90 | 22.00 | 7.81 | 29.82 | 7.61 | 4007 | 7524 | 17.35 |
| T ₈ : Amrut Pani @ 500 L/ha with irrigation at sowing, 30 to 40 and 50 to 60 DAS | 3.70 | 21.49 | 7.24 | 29.57 | 6.71 | 3859 | 7438 | 17.23 |
| T ₉ : Cow urine @ 500 L/ha with irrigation at sowing, 30 to 40 and 50 to 60 DAS | 2.98 | 20.15 | 5.50 | 27.11 | 5.46 | 3366 | 6719 | 17.09 |
| T ₁₀ : Control | 2.38 | 19.68 | 4.50 | 26.44 | 5.15 | 3277 | 6612 | 17.32 |
| S.E.m. _± | 0.14 | 0.75 | 0.29 | 1.26 | 0.09 | 186 | 324 | 0.71 |
| C.D. at 5% | 0.40 | 2.15 | 0.82 | 3.60 | 0.26 | 534 | 931 | NS |
| C.V.% | 9.17 | 8.30 | 9.65 | 10.15 | 3.13 | 11.16 | 10.35 | 9.75 |

Conclusion

Based on the outcomes of this two-year field experiment, it is concluded that using *Panchgavya* @ 3% foliar spray at 30, 45 and 60 DAS or Banana sap @ 1% foliar spray at 30, 45 and 60 DAS in addition to applying 10 t/ha of FYM to the soil prior to sowing in organic pearl millet grown in the South Saurashtra region is beneficial because it produced noticeably higher yields.

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