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Original Article

COMPARATIVE PERFORMANCE OF SEED TREATMENT BY BIJAMRITA AND BAVISTIN ON SEEDLING GROWTH OF MAIZE (*Zea mays* L.) AND FINGER MILLET (*Eleusine coracana* L.)

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ABSTRACT

The trial was conducted to study the comparative performance of seed treatment by bijamrita and bavistin on germination percentage and seedling growth of maize and finger millet. The treated seeds of maize resulted in increased seed germination percentage of 93 % in bijamrita whereas germination varied from 77 to 93%. The seed germination percentage in finger millet ranged from 61-77 % with highest in bijamrita treated seeds (71%). Significantly highest shoot length (47.72 cm) and seedling length (70.82 cm) was found in bijamitra in comparison to the chemical treatments in maize. The chemical treated seeds with bavistin recorded higher root length (19.6 cm) and root volume (7.91cc) in maize. Whereas, highest fresh weight (10.72 g) and seed vigour index (6586) were observed in bijamrita treated seeds of maize. In finger millet, highest shoot length (9.35 cm), seedling length (16.55 cm), root length (7.2 cm) and root volume (2.18 cc) were found when the seeds were treated with bijamrita. The similar trend of highest fresh weight (1.64 g) and seed vigour index of 1286 was recorded in bijamrita treated seeds in finger millet. The use of bijamrita for seed treatment resulted in better seed germination percentage, seedling growth attributes and promotes eco-friendly agriculture of good practices devoid of chemicals.

KEYWORDS: Cow dung, Cow urine, Bijamrita, Bavistin, Seed germination & Seed vigour index

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INTRODUCTION

Organic or natural farming, a sustainable and environmental friendly way of farming with no use of chemicals are drawing attention of the world from since past few years. It is the adoption of eco-friendly and sustainable farming practices by use of organic amendments which can not only reverse the declining trend in global productivity but also helps in environment protection (Naikwade *et al*., 2012). The use of organic components like compost, vermicompost, green manures, crop residues as dried leaf, straw, etc. performed better results in seed germination, growth and yield attributes (Ghadge *et al*., 2013, Naikwade, 2014). The organic formulations like panchagvya, bijamrita and jivamrita are used in organic farming (Naik *et al*., 2013). The organic formulations play a major contribution for their germicidal and growth properties. These are prepared by fermentation process from locally and easily available ingredients at the farm having no major expenditure. These are the best sources of micro flora which is beneficial and support, stimulate the growth of plant in turn which helps in getting better vegetative growth and quality yield of produce (Devakumar *et al*., 2014). It aims to sustain agricultural production with eco-friendly processes free of synthetic chemicals and promoting good agronomic practices (Koner and Laha, 2020).

The cow dung from local cows significantly enhances the soil fertility and soil productivity. Their use in sustainable agriculture has been mentioned in ancient Indian treaties like Charak Samhita, Sushrut, Vagbhaat and

Nighantu, Ratnakar, etc. The bijamrita prepared from locally available cow dung and cow urine is used for seed treatment before sowing (Swamy, 2009). The cow dung and urine of desi cows (*Bos indicus*) used for making jivamrita has superior micro culture as compared to the exotic breeds (Palekar, 2005). Bijamrita a homemade microbial liquid formulation for seed treatment made up of ingredients as of jivamrita for seed treatment, seedlings or any planting materials. It is very effective in protecting the seedlings from soil or seed borne diseases and young developing roots from the fungus (Khadse *et al.*, 2017).

Bijamrita seed treated showed enhanced germination, protects from phytopathogenic infections and increases plant vigour (Palekar, 2006). Bijamrita a technique of seed treatment prepared from locally available ingredients. It protects seed from harmful soil borne and seed borne pathogens during the initial stages of germination and establishment. Similar observations was also reported by Devakumar *et al.* (2008) and Srinivas *et al.* (2010) that many beneficial micro-organisms *viz*., nitrogen fixers, phosphorus solubilizers, actinomycetes and fungi are present in jivamrita and bijamrita formulations. The use of bijamrita, a very traditional knowledge in India and also documented by researchers that organic manures contain essential required nutrients, which result in increased crop growth and yield (Naikwade, 2017).

It is also evident when any poisonous fungicide is applied to the seed, it destroys the useful effective microorganisms of the soil. As soon as seeds treated with poisonous chemicals the seeds germinate, grow and absorb the harmful chemicals and translocate to various parts of the plant. The performance of organic treatments must be studied for its comparison to chemical treatment. Therefore, study was conducted to compare the performance of treatment by Bijamrita and Bavistin on seed germination and seedling growth behaviour of maize (*Zea mays* L.) and finger millet (*Eleusine coracana* L.).

MATERIALS AND METHODS

The research trial was conducted during July, 2020 at ICAR-RCER, FSR Centre for Hill & Plateau Region, Ranchi, Jharkhand, India. The organic treatment formulations were prepared by using cow urine and dung collected from local *desi* breed of cows. Seed germination percentage was calculated after seven days of sowing. The root, shoot, seedling length, root length and root volume was also recorded. The Seed Vigour Index (SVI) was also recorded of 21 days old seedling. The three treatments comprised of control (T_0), bavistin (T_1) and bijamrita (T_3) for comparative study of bijamrita and bavistin on seeds of maize and finger millet with replications of seven each. The five seedlings were randomly selected from each replication following completely randomized design (CRD).

Preparation of Bijamrita

Bijamrita solution was prepared by using locally available ingredients as enlisted in Table 1. The bijamrita was prepared as per the method given by Palekar (2007). The formulation of bijamirta consists of local *desi* fresh cow dung, cow urine, lime, water and handful soil from the bund of the experimental site. The 5 kg of desi cow dung placed in a cotton cloth and bounded by tape and submerged in 20 litres of water for 12 hrs. Further, 50g slaked lime dissolved in 1 litre of water in separate container and it was kept for overnight. This bundle of cow dung was squeezed thrice after 12 hours. Thus the essence of cow dung accumulated in water are drawn to water phase (cow dung extract). Later on, 1 kg of soil from experimental site of bund was dissolved in cow dung extract by stirring it well. Afterwards, to this, 5 litres of desi cow urine and lime water added and mixed thoroughly. Finally the seeds of maize and finger millet were soaked in prepared bijamrita formulations for overnight *i.e.*, 12 hours, afterwards dried in shed and finally used for seed germination study.

Table 1: Ingredients used for Preparation of Bijamrita

Sl. No.	Ingredients	Quantity
1.	Water	5 Litre
2.	Desi Cow dung (Fresh)	1.25 Kg
3.	Desi Cow Urine (Fresh)	1.25 Litre
4.	Agriculture lime	12.5 gm.
5.	Soil from Experimental bund	Handful

Preparation of Rooting Media

The rooting media was prepared from cocopeat and vermicompost in the ratio of 1:1. The cocopeat was soaked in water for 2 hours and later on crushed and mixed thoroughly. The protray of 40 cavities was filled with these mixtures and seeds were sown in the cavity and kept in poly house for further study.

Microbial Analysis

The colony forming units (cfu) were estimated through serial dilution plating on a nutrient medium by the most widely accepted method for monitoring the cultivable bacteria and yeasts in different spheres of microbiology as shown by Messer *et al*. 2000.

Seed Treatment and Seed Sowing

These treated seeds of bijamitra (100 %), bavistin @ 2 g/kg of seed and untreated seeds soaked in distilled water were sown in experimental protrays. These treated seeds with bijamrit, bavistin and control were soaked for 12 hours. After sowing of treated seeds, protrays were kept in poly house where optimum temperature and humidity was maintained till 21st days of observation. The moisture was provided with the help of water can on daily basis to all protrays uniformly. The seed germination percentage was calculated as,

Seed Germination Per cent

The per cent of seed germination was calculated at seven days after seed germination by using the formula as reported by Sumithra *et al*. 2006.

$$\text{Germination (\%)} = \frac{\text{Number of seeds germinated}}{\text{Total number of seeds sown for germination}} \text{ x } 100$$

Root, Shoot and Seedling Length, Root Volume and Fresh Weight:

Five seedlings selected randomly from the each replications of each treatment *i.e.*, 35 seedlings after 7 days of seed germination. The root, shoot and total seedling length was measured at 21 days old seedlings age. The root volume, fresh weight and seed vigour index of seedling was also determined at 21 days and it was ready for transplanting.

Seed Vigour Index (SVI):

Seed Vigour Index (SVI) was calculated by the formula as given by Abdul and Anderson, 1973,

Seed Vigour Index (SVI) = Germination percentage x Length of Seedling (Root+Shoot)

Statistical Analysis:

The results statistically analysed by using analysis of variance (ANOVA) test as shown by (Snedecor and Cochran, 1989). The treatments means as calculated were compared by using the least significant difference (CD p=0.05) which allowed the determination of significance between their different treatments.

RESULTS AND DISCUSSIONS

The seed treatments with bijamrit, bavistin and untreated control were studied for seed germination and seedling growth behaviour. The bijamrita formulation was analysed for physico- characteristics and microbial counts are presented in Table 2. The ingredients present in bijamrit showed pH 9.5, EC 1.43, nitrogen (40 ppm), phosphorus (155.4 ppm) and potassium (285.50 ppm).The fungal and bacterial colony of microbial count present in bijamrita are 0.90±0.20 $\times 10^5$ cfu/ml and 24.17±1.04 $\times 10^8$ cfu/ml of sample, respectively.

Table 2: Physico- characteristics & Microbial Count of Bijamrita Formulation

Parameters	pH	EC	Nitrogen (ppm)	Phosphorus (ppm)	Potassium (ppm)	Fungal colony (cfu/ml of sample) x 10^5	Bacterial colony (cfu/ml of sample) x10^8
Bijamrita	9.50	1.43	40.00	155.40	285.50	0.90±0.20	24.17±1.04

Seed Germination (%)

The effect of seed treatments with bijamrita, bavistin and untreated seeds (control) of maize and finger millet are presented in Table 3 and Table 4.The maximum germination per cent was observed in seeds of maize and finger millet when treated with bijamrita as compared to bavistin and control. The bijamrita treated seeds resulted in seed germination percentage of maize (93%) whereas finger millet (77%), however, germination varied from 77 to 93% in maize and 61-77% in finger millet respectively. The result of higher seed germination percentage in bijamrita treated seeds might be due to the presence of useful bacteria in bijamrita, which may produces Indole Acetic Acid (IAA) and Gibberellic Acid (GA) as reported by Sreenivasa *et al*. 2009 and Shakuntala *et al*. 2012. The bijamrita treated seeds also recorded higher germination and having more amylase enzyme activity as compared to the seed soaked in water as also witnessed by Shakuntala *et al*. 2012. The Karuppaswamy and Perumal, 2013 reported equal combination of bijamrita (25%) and cyanospray (0.3%) resulted better than the other treatments of seed germination. Seed germination percentage in bijamrita treated seeds was significantly higher than the seed germination percentage of other treatments. A similar finding was also reported by Nagaraja (2009) who observed better growth of chilli in bijamirta treated seeds compared to other treatments. Earlier experiment also showed seeds treated with biofertilizers reduced days for germination and increased seed germination percentage (93.33) in garden pea (Pawar *et al*., 2015). The bijamrita treatment resulted significant effect on seed germination per cent, increased morphological parameters *i.e*., epicotyls and hypocotyls length, number of radical and increase in biochemical contents of seed in *Zea mays* L. (Subramaniyan and Malliga, 2016).

Table 3: Performance of Bijamrita and bavistin treatments on Seed Germination of Maize (21 days old seedlings)

Crop	Treatments	Germination (%)	Length of Shoot (cm)	Length of Root (cm)	Length of Seedling (cm)	Root volume (cc)	Fresh weight (g)	Seed Vigour Index
Maize	Control (T_0)	79.0	34.45	18.8	53.25	7.53	4.39	4207
	Bavistin (T_1)	85.5	41.47	19.6	61.08	7.91	8.88	5221
	Bijamrita (T_2)	93.0	47.72	18.8	70.82	7.53	10.72	6586
SEm ±		2.11	1.63	0.936	2.63	0.171	0.473	312
Cd($p \leq 0.05$)		4.72	6.23	2.88	7.37	0.19	0.80	1188

Table 4: Performance of Bijamrita and Bavistin Treatments on Seed Germination of Finger Millet (21 days old seedlings)

Crop	Treatments	Germination (%)	Length of Shoot (cm)	Length of Root (cm)	Length of Seedling (cm)	Root volume (cc)	Fresh weight (g)	Seed Vigour Index
Finger Millet (Ragi)	Control (T_0)	61	6.57	5.55	12.12	1.025	1.36	735
	Bavistin (T_1)	65	8.37	6.55	14.92	1.535	1.35	967
	Bijamrita (T_2)	77	9.35	7.2	16.55	2.18	1.64	1286
SEm ±		2.61	1.09	0.27	1.22	0.15	0.05	105
Cd ($p \leq 0.05$)		11.76	2.05	1.21	2.38	0.20	0.24	292

Shoot, Root and Seedling Length, Root Volume and Fresh Weight

The growth attributes of different treated seeds for shoot, root and seedling length, root volume and fresh weight of seedling was recorded at final stage of 21 days after seed sowing. The results obtained are presented in Table 3 and Table 4. The organic treatments performed better results than the chemical and control as shown in Figure 1, 2 and 3 in maize and Fig.4, 5 and 6 in finger millet respectively. The maximum shoot and seedling length, fresh weight were observed in bijamrita (T_2) treated seeds followed by bavistin (T_1) and least in untreated seeds as control (T_0).However, maximum root length (19.6 cm) and root volume (7.91 cc) was found in bavistin treated seeds of maize.

The maximum shoot length (47.72 cm) of maize was found in bijamrita treated seeds and found significantly higher in comparison to other treatments. Similarly, significantly highest shoot length was observed in bijamrita treated seeds of finger millet (9.35 cm) also.

Figure 1: Growth of maize seedlings at 10 DAS under different seed treatments

Figure 2: Growth of maize seedlings at 14 DAS under different seed treatments

Figure 3: Growth of maize seedlings at 21 DAS under different seed treatments

Figure 4: Growth of Finger millet (Ragi) seedlings at 10 DAS under different seed treatments

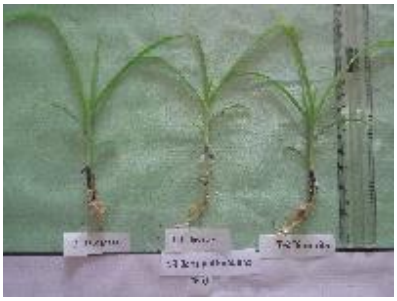

Figure 5: Growth of Finger millet (Ragi) seedlings at 14 DAS under different seed treatments

Figure 6: Growth of Finger millet (Ragi) seedlings at 21 DAS under different seed treatments

Shoot length was found significantly higher in the seeds treated with bijamrita as compared to chemical and control which may be due to the production of IAA and GA by the bacteria present in bijamrita that could have stimulated seedling length compared to chemical and control. The similar finding was also reported by Sreenivasa *et al*. 2009. The maize recorded maximum seedling length of 70.82 cm in bijamrita treated seeds. Similar trend in seedling length was also observed in finger millet (16.55 cm) with bijamrita. Also, the root length was recorded maximum in organic treated seeds with bijamrita in finger millet. However, bavistin treated seeds in maize recorded maximum root volume (7.91 cc). The rooting pattern of bijamrita treated seed in maize at 14 and 21 days old seedlings are depicted in Figure 7 & 8 and 9 & 10 of finger millet respectively.

Figure 7: Rooting pattern of maize seedlings at 14 DAS under different seed treatments

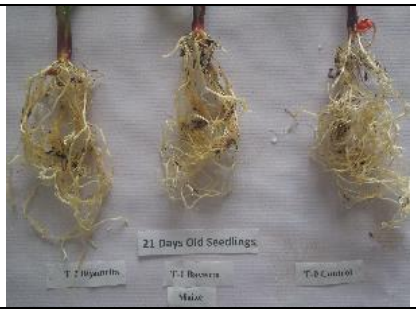

Figure 8: Rooting pattern of maize seedlings at 21 DAS under different seed treatments

Figure 9: Rooting pattern of Ragi seedlings at 14 DAS under different seed treatments

Figure 10: Rooting pattern of Ragi seedlings at 21 DAS under different seed treatments

The maximum root length and root volume in finger millet (7.2 cm and 2.18 cc) was recorded in bijamirta treated seeds compared to other treatments. The maximum fresh weight of seedling was found in bijamrita treated seeds. The maximum fresh weight in maize (10.72 g) was recorded with bijamirta treated seeds compared to other treatments. Finger millet also showed significantly higher fresh weight of 1.64 g respectively.

Seed Vigour Index (SVI)

The Seed Vigour Index (SVI) was also found better in bijamrita treated seeds. In maize recorded significantly highest seed vigour index (SVI) of 6586. Similarly in finger millet, bijamrita treated seed showed significantly highest seed vigour index (SVI) of 1286 respectively. The organic treatments showed better results than chemically treated and control. Naikwade, 2019 also reported high germination percentage, seedling growth and seed vigour index in leguminous seeds treated with bijamrita. Similar findings was also reported by Devakumar *et al*. 2014 who observed that jivamrita and bijamrita mobilized more plant nutrients and provided the plant growth promoting substances and other micro nutrients required by the plants. The micro-organisms present in the organic formulations that convert raw nutrients into easy -to-digest form that plants can absorb and use efficiently for better crop growth. The beneficial microorganisms present in bijamrita protect plant against several harmful soil and seed borne pathogens. The bacteria isolated from bijamrita are capable of Nitrogen fixation, Phosphorus solubilisation and growth promoting hormones *viz*., IAA, GA production in addition to the suppression of *Sclerotium* (Sreenivasa *et al*., 2009).

The beneficial microorganisms present in bijamrita and jivamrita might be virtue of their constituents such as desi cow dung and urine, legume flour and jaggery containing both macro, and essential micro nutrients, vitamins, essential amino acids, growth promoting substances *viz.*, Indole Acetic Acid, Gibberlic Acid and beneficial microorganisms as reported by Palekar, 2006 and Sreenivasa *et al*., 2010.

Jivamrita and panchagavya also enhanced the growth of nitrogen fixers in locally available substrates as press mud, compost and digested biogas slurry (Devakumar *et al*., 2011). The greater number of beneficial microorganisms also recorded in panchagavya under higher acidity. These microorganisms secrete proteins, organic acids and antioxidants in presence of organic matter which convert them into energy, thereby the soil micro flora and fauna changes the disease inducing soil to disease suppressive soil (Somasundaram *et al*., 2003).

The reason behind the better performance of bijamrita might be due to the micro-organisms associated with it. Swaminathan (2005) also revealed that naturally occurring beneficial microorganism's viz., bacteria, yeasts, actinomycetes, photosynthetic bacteria and certain fungi present in cow dung, which is the major component of bijamrita. Thus Bijamrita contains macro as well as micro nutrients, many vitamins, essential amino acids, growth promoting

hormones like Indole Acetic Acid (IAA), Gibberellic Acid (GA) and beneficial microorganisms (Natrajan, 2007).

These findings are also in support of Karuppaswamy and Perumal, 2013 as seed germination and seedling growth attributes are well regulated physiological process involving high metabolic activity. The germination of seeds results in increase of general metabolic activities and initiates the occurrence of seedling from the embryo (Subramaniyan and Malliga, 2016). The water as absorbed by seeds and enzymes viz., lipases, proteinases, phosphatases and hydrolases acts on the seed in turn helping to break down the storage materials (Bewley and Black, 1985). These breakdown products further transported from seed and utilized for synthesis of new materials (Arteca, 1997). The maximum colonies of bacteria, fungi, actinomycets, N-fixers and P-solubilizers are present in bijamrita while on the day of preparation and later on it sharply decline in their number as the days elapsed (Devakumar *et al*., 2014). The presence of these beneficial microorganisms in organic formulations might be mainly due to their active constituents such as fresh desi cow dung and urine, legume flour and jaggery as associated microorganisms and their products (Palekar, 2006; Sreenivasa *et al*., 2010). Many environmental groups and governments have also demanded decrease of inorganic fertilizer use in agriculture to diminish nutrient leaching into ground water resulting in water pollution (Naikwade, 2014).

CONCLUSIONS

Bijamrita easy to prepare and made from locally available ingredients at farmers doorstep very useful to increase seed germination percentage, seedling growth attributes and seed vigour index. The result revealed an application of bijamitra in seed treatment of maize performed significantly better in comparison to the chemically treated seeds. High germination percentage, increased root, shoots, seedling length, root volume and seed vigour index was found when seeds were treated with bijamrita. However, further research is also needed to analyse the penetration and translocation of ingredients present in bijamrita treated seeds and activated processes resulting in better performance of seed germination and seedling growth. The expenditure incurred on production of bijamrita is also very less as it is made up from locally available ingredients at the farmers door step. Its regular use for seed treatment will reduce the use of chemicals and subsequently reduces the pollution caused by chemicals and it is eco-friendly and must be popularized on larger domain.

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