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Effect of Bijamrita and other organic liquid treatments on seed germination and seedling growth of legume crops

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Abstract

Cow dung and cow urine have been used in India from ancient time for various organic formulations and various medicines moreover well known for their germicidal and medicinal properties. Bijamrita is a technique of seed treatment from locally available ingredients including local *desi* cow urine and cow dung. The experiment was carried out to evaluate effectiveness of organic liquid treatments including Bijamrita on seed germination and seedling growth of legume crops. Seeds of four major legume crops i.e. *Arachishypogaea* L. (Ground nut), *Glycine max* (L.) Merr.(Soybean), *Vignaaconitifolia* (Jacq.)Marechal (Moth bean) and *Vignaradiata* (L.) R. Wilczek. (Green gram) commonly grown in Maharashtra were collected from local market. Germination percentage was calculated by following paper towel method.Total Treatments were seven with four replicates each viz.T1: Bijamrita 25%,T2: Bijamrita 50%, T3: Bijamrita 75%, T4: Bijamrita 100%, T5: Local *desi*cow dung extract, T6: Local *desi* cow urine, T7: Control. Seed germination percentage was calculated after seven days. The root, shoot length and total seedling length was measured and Seed Vigor Index (SVI) was calculated.Bijamrita and other organic treatments were easy to prepare made from locally available ingredients were useful to increase seed germination percentage of all four legume crops. Root, shoot and total seedling length was also increased when seeds were treated with organic liquid formulations. When compared different concentrations of Bijamrita; 100% Bijamrita showed high germination percentage, seedling growth and Seed Vigour Index. Bijamrita is recommended for the farmers to use in agriculture. It's regular use for seed treatment will reduce dependence on use of chemicals and subsequently reduces pollution caused by chemical treatments.

KEYWORDS: *Arachishypogaea*, Cow dung, *Glycine max*, Seed Vigour Index, *Vignaaconitifolia*, *Vignaradiata*

Introduction

Organic farming is drawing attention of the world since past few years; it is environment friendly, sustainable way of farming with zero use of chemicals. Adoption to ecofriendly and sustainable farming practices like use of organic treatments can not only reverse the declining trend in global productivity but also will help in environment protection (Naikwade et al.,2012). In the past few years thousands of farmers in India have committed suicide due to increased cost of production and low productivity. Organic farming reduces use of chemicals and protects plants from infection in natural way.

Many organic manures like compost, vermicompost, green manures, dry leaf powder etc. showed better results in terms of seed germination, crop growth and yield (Ghadge et al.,2013, Naikwade 2014). Liquid organic formulations like Panchagavya, Bijamrita and Jivamrita are used in organic farming. These are prepared by fermentation process from locally available ingredients in the farm. These are the rich sources of beneficial micro flora which support, stimulate the plant growth, help in getting better vegetative growth and also good quality yield (Devakumar et al.,2014).

Cow dung and cow urine have been used in India from ancient time for various organic formulations and various medicines moreover well known for their germicidal and medicinal properties. Their use in sustainable agriculture has been mentioned in ancient Indian treaties like CharakSamhita, Sushrut, Vagbhaat and Nighantu, Ratnakar etc. Bijamrita is prepared from cow dung and cow urine and used for seed treatment before sowing (Subramaniam, 2009).

Use of eco-friendly, organic treatments are recommended than chemical treatment to seeds. When any poisonous fungicide is applied to the seed, useful effective microorganisms are also destroyed in the soil. As soon as seeds treated with poisonous chemicals germinate and grow, chemicals are also absorbed by the roots along with soil water solution and then transferred and deposited in various body organs of the plant. Seedlings of many plants are susceptible to many diseases. Bijamrita (Bija-seed; Amrita-elixer) also known as Bijamrita is a traditional biofertilizer especially used for seed treatment. It enhances germination, protects from phytopathogenic infections and increases till ring and plant vigour (Palekar, 2006).

Bijamrita is a technique of seed treatment from locally available ingredients. It protects the crop from harmful soil borne and seed borne pathogens during the initial stages of germination and establishment. Devakumar et al., (2008) and Srinivas et al., (2010) have reported the presence of many beneficial microorganisms viz., nitrogen fixers, phosphorus solubilizers, actinomycetes and fungi in Jivamrita and Bijamrita.

Using bijamrita is traditional knowledge in India. In earlier experiments it was proved that organic manures contain essential required nutrients which result in increased crop growth and yield (Naikwade 2017). Very few references are available about scientific study of effect of Local cow urine, cow dung and bijamrita on seed germination of important legume crops. *Arachishypogaea* L. (Ground nut), *Glycine max* (L.) Merr. (Soybean), *Vigna conitifolia* (Jacq.) Marechal (Moth bean) and *Vignaradiata*. (L.) R. Wilczek. (Green gram) are economically are used for production of oil and pulses and are integral part as food in Maharashtra. This experiment was carried out to evaluate effectiveness of organic liquid treatments including Bijamrita on seed germination and seedling growth of these legume crops.

Material and Methods

The experiment was carried out at Department of Botany, ASP College Devrukh, Maharashtra, India. Organic liquid treatments were prepared and used as follows. Urine and dung used in these formulations were from collected from local *desibreed* of cows and not from cross-breed or foreign breeds.

Preparation of Bijamrita solution

Bijamrita solution was prepared by using locally available ingredients as listed in Table 1. Method of preparation was followed as given by Palekar, (2007). 5 Kg of local cow dung was taken in a cloth and bound by tape and was submerged in 20 liters of water for 12 hrs. Simultaneously, 50g of slaked lime was dissolved in 1liters of water in separate container and kept stable for overnight. After 12 hrs, this bundle of cow dung was squeezed thrice, thereby: all the essence of cow dung will be drawn to water phase (cow dung extract). 1Kg of soil was dissolved in cow dung extract by stirring it well. To this, 5liters of wild cow urine and lime water was added and mixed well. The seeds were immersed in Bijamrita solutions of different concentrations (25%, 50%, 75% and 100%) for 12 hours then dried in shed and later used for germination study.

Preparation of cow dung extract

1 kg of fresh *desicow* dung was taken and mixed with 10 liters of water then extract was filtered with cloth. Afterwards 5 liters of water was added to the filtrate and filtration process was repeated. Then clear cow dung solution (extract) obtained used for seed treatment solution. The seeds were immersed in Cow dung Extract solution for 12 hours then dried in shed and later used for germination study.

Local *desi* cow urine

Local *desi* cow urine was used without addition of other ingredient. 500 ml of cow urine was diluted in 2 ½ liters of water. Then seeds to be treated were tied in plain cotton cloth and soaked in the cow urine for 12 hours and then seeds were dried in shade before use.

Seed germination

Seeds of four major legume crops i.e. *Arachishypogaea* L. (Ground nut), *Glycine max* (L.)Merr.(Soybean), *Vignaaconitifolia* (Jacq.)Marechal (Moth bean) and *Vignaradiata* (L.) R. Wilczek. (Green gram) commonly grown in Maharashtra were collected from local market. Germination percentage was calculated by following paper towel method. Sterilization of Petri-plates was done by using absolute alcohol and lined with filter paper at bottom. Twenty healthy and uniform seeds were selected and placed in each Petri-plate. These seeds were treated with different concentrations of standard Bijamrita (25%, 50%, 75% and 100%), Local *desicow* dung extract, Local*desi* cow urine and compared with control i.e. distilled water. After treatment petri plates were kept in BOD incubator at 27⁰C in dark for incubation. Optimum temperature and humidity is maintained till seven days.

Treatments: 07with four replicates each

T1: Bijamrita 25%

T2: Bijamrita 50%

T3: Bijamrita 75%

T4: Bijamrita 100%

T5: Local *desicow* dung extract

T6: Local desi cow urine

T7: Control

Seed germination %

To study impact of organic treatments legume seeds were treated with four replicates. Seed germination percentage was calculated after seven days by using following formula (Sumithra et al.,2006).

Germination (%) = Number of seeds germinated/ Total number of seeds kept for germination X 100.

Root, Shoot and Seedling Length:

From all seven treatments five normal seedlings were selected by random selection method from four replicate in each treatment (20 seedlings for one treatment) after seven days of germination. The root, shoot length and total seedling length was measured and mean length was calculated.

Seed Vigor Index (SVI):

Seed Vigor Index (SVI) was determined by following Williamson and Richardson (1988) by using formula

Seed Vigor Index (SVI) = Germination percentage X Seedling Length (Root+Shoot)/100

Statistical Analysis:

All the results were statistically analyzed using analysis of variance (ANOVA) test and treatments means were compared using the least significant difference (C.D. $p = 0.05$) which allowed determination of significance between different applications.

Results and Discussion

Impact of organic liquid treatments on seed germination percentage and seedling growth was studied.

Impact on *Arachishypogaea* L. (Ground nut) seeds

The effect of organic liquid treatments on *Arachishypogaea* L. (Ground nut) seeds is given in Table 2. Highest germination percentage was observed in seeds treated with 100% Bijamrita. Maximum root and shoot length in seedling was observed in T3 treatment and T4 respectively however maximum seedling length and Seed Vigour Index (SVI) was shown in 100% Bijamrita treated seeds. All organic treatments showed better results than control.

Impact on *Glycine max* (L.) Merr. (Soybean) seeds

Germination percentage was in the range of 83 to 96% (Table 3). Seeds treated with 100% Bijamrita showed highest germination. Same trend was followed in case of root, shoot length, total seedling length and SVI. However all organic treatments performed better than control.

Impact on *Vigna conitifolia* (Jacq.) Marechal (Moth bean) seeds

The influence of organic liquid treatments on *Vigna conitifolia*(Jacq.)Marechal (Moth bean)seeds reported in Table 4. Highest seed germination was seen in T4 treatment i.e. 100% Bijamrita and lowest was found in T6 treatment i.e. cow urine. Similar results were observed followed in case of root, shoot length, total seedling length and SVI.

Impact on *Vigna radiata*.(L.) R. Wilczek.(Green gram) seeds

The results of impact of organic liquid treatments on *Vigna radiata*.(L.) R. Wilczek.(Green gram) seeds are reported in Table 5. Range of seed germination percentage was in the range of 85 to 97%. Highest seed germination percentage was seen in T3 and T4 treatment. Highest root length, shoot length was observed in T4 and T3 treatments respectively. Total seedling length,Seed Vigour Index was observed in T4 treatment.

In four legume crops used all organic treatments showed better seed germination and seedling growth as well as Seed Vigour Index except few exception. T4 treatment i.e. 100 % Bijamrita showed better results than other organic treatment and control. Earlier experiment showed that seeds treated with biofertilizers reduced days for germination and increased seed germination percentage (93.33) in garden pea (Pawar et al.,2015). The result of Bijamrita treatment showed significant effect on germination percent, increase in morphological parameters such as epicotyls length, hypocotyls length, and number of radical, and increase in biochemical contents of *Zea mays* L. seed (Subramaniyan and Malliga, 2016).

Germination caused an increase in amino acid and amylase content in combination of 25% Bijamrita and 0.3% cyanospray (50:50) at 48hrs. The equal combination of Bijamrita (25%) and cyanospray (0.3%) showed better result than other treatments of seed germination (Karuppaswamy and Perumal 2013). Seed germination percentage in Bijamrita treated rice seeds was significantly higher than the seed germination percentage of control, calcium choride and cyanospray. The radical and coleoptile length was also reported more in case of Bijamrita treated rice seeds. Nagaraja (2009) showed that in organic seed treatment of chilli plant, Bijamrita was superior to control and other treatments.

The reason behind the better performance of Bijamrita treatment is may be the components and microorganisms associated with it. Swaminathan (2005) showed that naturally occurring beneficial microorganisms mainly bacteria, yeasts, actinomycetes, photosynthetic bacteria and certain fungi were detected in cow dung which is one of component of Bijamrita. Bijamrita contain macro as well as micro nutrients, many vitamins, essential amino acids, growth promoting factors like Indole Acetic Acid(IAA), gibberellic acid (GA) and beneficial microorganisms (Natrajan 2007,Sreenivasa 2010).

Seed germination and seedling development are well regulated process in plant physiology involving high metabolic activity. (Karuppaswamy and Perumal 2013). Germination of seeds involves a rise in general metabolic activity and initiates the formation of a seedling from the embryo(Subramaniyan and Malliga, 2016). Water is absorbed by seeds and enzymes such as lipases, proteinases phosphatases and hydrolases act on the seed thereby helping to break down the storage materials (Bewley and Black,

1985). The breakdown products then transported from seed and utilized for synthesis of new materials (Arteca, 1997). According to Devakumar et al., (2011) Jeevamrutha and Panchagavya have enriched the growth of nitrogen fixers in locally available substrates such as FYM, compost and digested biogas slurry etc.

Maximum colonies of bacteria, fungi, actinomycetes, N-fixers and P-solubilizers were present in Bijamrita on the day of preparation and later on there was sharp decline in their number as the days elapsed. and maximum CFUs of bacteria (623), fungi (22) actinomycetes (2), N-fixers (71) and P-solubilizers (52) were recorded on the day of preparation of Bijamrita. (Devakumar et al.,2014). The presence of beneficial microorganisms in organic liquid formulation might be mainly due to their constituents such as: cow dung, cow urine, legume flour and jaggery and associated microorganisms and their products (Palekar, 2006; Sreenivasa et al., 2010).

Organic treatments supply micro and macro nutrients to crops resulting in improved growth and yield (Ghadge et al.,2013, Naikwade et al.,2011), Organic manure treatments showed long term effect on *Vigna unguiculata* and increased productivity (Mogle et al.,2013). The microbial experiments have shown that greater bacterial population was recorded followed by Nitrogen fixers, Phosphorus solubilizers, fungi and actinomycetes. These higher beneficial microorganisms may help in mobilising more plant nutrients and required plant growth promoting substances and other micro nutrients are made available to the plants (Devakumar et al 2014). Many environmental groups and governments have demanded decrease of inorganic fertilizer use in agriculture to diminish nutrient leaching into ground water or water pollution (Naikwade 2014). Similarly instead of applying chemical treatments to seeds organic liquid treatments must be advocated.

Conclusion

Bijamrita and other organic treatments were easy to prepare made from locally available ingredients were useful to increase seed germination percentage of *Arachis hypogaea* L. (Ground nut), *Glycine max* (L.)Merr.(Soybean), *Vigna conitifolia* (Jacq.)Marechal (Moth bean) and *Vigna radiata*. (L.) R. Wilczek. (Green gram). Root, shoot and total seedling length was also increased when seeds were treated with organic liquid formulations. When compared different concentrations of Bijamrita; 100% Bijamrita showed high germination percentage, seedling growth and Seed Vigour Index. For understanding possible mechanism of Bijamrita on seed germination and seedling growth further research is needed to analyze penetration and transport of ingredients of Bijamrita inside the seeds and processes activated. The cost of production of Bijamrita is very less as it is made from locally available ingredients. Bijamrita is recommended for the farmers to use in agriculture. It's regular use for seed treatment will reduce dependence on use of chemicals and subsequently reduces pollution caused by chemical treatments.

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Table 1 Ingredients used for preparation of Bijamrita

Sr. No.	Ingredient	Quantity
1	Water	21 L
2	Cow Dung	5 Kg
3	Cow Urine	5 L
4	Lime	50 gm
5	Soil from bund	Handful

Table 2. Impact of organic liquid treatments on *Arachishypogaea* L. (Ground nut) seeds (After 7 days)

Treatment	Germination %	Root length (cm)	Shoot length (cm)	Seedling Length (cm)	Seed Vigor Index
T1 Bijamrita 25%	85	6.39	3.8	10.19	866
T2 Bijamrita 50%	89	10.62	5.29	15.91	1416
T3 Bijamrita 75%	92	12.03	6.16	18.19	1673
T4 Bijamrita 100%	93	11.74	6.48	18.22	1694
T5 Cow dung extract	88	6.24	3.07	9.31	819
T6 Cow urine	84	5.85	2.91	8.76	736
T7Control	81	5.70	2.75	8.45	684
Standard Error (SE)	1.78	1.20	0.65	1.84	183.77
Critical Difference (CD)	4.35	2.94	1.60	4.52	450.23

Table 3. Impact of organic liquid treatments on *Glycine max* (L.) Merr. (Soybean)seeds (After 7 days)

Treatment	Germination %	Root length (cm)	Shoot length (cm)	Seedling Length (cm)	Seed Vigor Index
T1 Bijamrita 25%	88	15.10	9.36	24.46	2152
T2 Bijamrita 50%	93	16.20	10.85	27.05	2516
T3 Bijamrita 75%	94	18.28	11.44	29.72	2794
T4 Bijamrita 100%	96	18.39	12.54	30.93	2969
T5 Cow dung extract	89	15.60	10.55	26.15	2327
T6 Cow urine	86	14.98	10.34	25.32	2178
T7Control	83	15.73	9.06	24.79	2058
Standard Error (SE)	1.91	0.58	0.49	1.02	141.44
Critical Difference (CD)	4.67	1.43	1.19	2.51	346.52

Table 4. Impact of organic liquid treatments on *Vigna conitifolia* (Jacq.) Marechal (Moth bean) seeds (After 7 days)

Treatment	Germination %	Root length (cm)	Shoot length (cm)	Seedling Length (cm)	Seed Vigor Index
T1 Bijamrita 25%	87	2.43	3.61	6.04	525
T2 Bijamrita 50%	93	2.55	3.87	6.42	597
T3 Bijamrita 75%	93	2.69	4.09	6.78	631
T4 Bijamrita 100%	95	2.84	4.26	7.1	675
T5 Cow dung extract	88	2.13	3.52	5.65	497
T6 Cow urine	82	1.87	3.37	5.24	430
T7 Control	83	1.94	3.48	5.42	450
Standard Error (SE)	2.09	0.15	0.14	0.29	37.98
Critical Difference (CD)	5.12	0.38	0.34	0.70	93.06

Table 5. Impact of organic liquid treatments on *Vigna radiata* (L.) R. Wilczek. (Green gram) seeds (After 7 days)

Treatment	Germination %	Root length (cm)	Shoot length (cm)	Seedling Length (cm)	Seed Vigor Index
T1 Bijamrita 25%	91	2.07	2.90	4.97	452
T2 Bijamrita 50%	94	2.15	3.06	5.21	490
T3 Bijamrita 75%	97	2.32	3.14	5.46	530
T4 Bijamrita 100%	97	2.39	3.12	5.51	534
T5 Cow dung extract	88	1.85	2.69	4.54	400
T6 Cow urine	89	1.73	2.58	4.31	384
T7 Control	85	1.62	2.54	4.16	354
Standard Error (SE)	1.88	0.12	0.11	0.22	29.40
Critical Difference (CD)	4.61	0.29	0.26	0.55	72.04