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EFFICACY OF SEED TREATMENT WITH BIJAMRITA AND BAVISTIN ON SEEDLING GROWTH OF CUCURBITS AND LEGUMES

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ABSTRACT
A detailed study on seed treatments with bijamrita and bavistin on cucurbits and legumes were undertaken. The bijamrita treated seeds in cucurbits and legumes showed highest germination in bitter gourd (92.5%) and vegetable soybean (84%). The bitter gourd, bottle gourd and cucumber showed significantly highest shoot length (14.45, 17.35 and 22.90 cm), root length (13.35, 10.03 and 12.10 cm) and seedling length (27.80, 27.40 and 34.35 cm) in comparison to bavistin. In leguminous black gram, cow pea and vegetable soybean treated with bijamrita showed highest shoot length (14.93, 24.38 and 25.77 cm), root length (8.10, 14.98 and 16.10 cm) and seedling length (23.02, 39.35 and 40.00 cm). Similarly, highest root volume (2.56, 4.45 and 2.20 cc), fresh weight (6.17, 14.18 and 6.07 g) and seed vigour index (2570, 2536 and 3022) recorded in bitter gourd, bottle gourd and cucumber. Similarly highest root volume (1.30, 2.56 and 6.70 cc); fresh weight (1.83, 8.56 and 7.60 g) and seed vigour index (1884, 2838 and 3525) in bijamrita treated seeds of black gram, cow pea and vegetable soybean. Seed treated with bijamrita in cucurbits and legumes has significant effect on seed germination and seedling growth which promote eco-friendly agriculture devoid of chemicals.

INTRODUCTION

Natural farming, a sustainable and environmental friendly way of farming with no use of chemicals, is drawing attention of the world since past few years. It is the adoption of ecofriendly 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 application of organic manures like compost, vermi compost, green manures, crop residues as dried leaf, straw, etc. showed better results in terms of seed germination, crop growth and yield potential (Ghadge *et al*., 2013, Naikwade, 2014). 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. Moreover, these formulations are prepared by fermentation process from locally and easily available ingredients at the farm having no major expenditure. Hence, these are the rich sources of beneficial micro flora which stimulates the plant growth and helps in better vegetative growth and quality yield (Devakumar *et al*., 2014). It also 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 of local cows enhances significantly the soil fertility and soil productivity which 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), which enhances germination, protects from phytopathogenic infections and increases plant vigour (Palekar, 2006). The cow dung and urine of indigenous cows (Bos indicus) are used for making jivamrita as it has a superior micro culture compared to that of introduced European breeds (Palekar, 2005). Bijamrita is a homemade microbial seed treatment made of similar ingredients as of jivamrita used for the treatment of seeds, seedlings or any planting materials. Therefore, it is effective in protecting seedlings against seed or soil borne diseases and young roots from fungus (Khadse *et al*., 2017). Devakumar *et al*. (2008) and Srinivasa *et al*. (2010) have also reported the presence of many beneficial micro organism *viz*., nitrogen fixers, phosphorus solubilizers, actinomycetes and fungi in jivamrita and bijamrita. Many researchers stated that organic manures contain essential required nutrients, which result in increased crop growth and yield (Naikwade, 2017).

Furthermore, chemical treated seed destroys the useful effective microorganisms of the soil and germinated seeds absorbs the harmful chemicals and translocates to various parts of the plant. Hence, the efficacy of organic seed treatments in cucurbits and legumes need to be evaluated. Therefore, a trial was initiated to evaluate the efficacy of Bijamrita and Bavistin treatments on seed germination and seedling growth of cucurbits *viz*., bitter gourd (*Momordica charantia* L.), bottle gourd [*Lagenaria siceraria* (Molina) Standl.], and cucumber

(*Cucumis sativus* L.) and legume crops *i.e.*, black gram [*Vigna mungo* (L.) Hepper], cow pea [*Vigna unguiculata* (L.) Walp.] and vegetable soybean [*Glycine max* (L.) Merr.].

MATERIALS AND METHODS

The experiment was carried out during July, 2020 at ICAR-Research Complex for Eastern Region, Farming System Research Centre for Hill and 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 and root volume was measured. The Seed Vigor Index (SVI) was also calculated in 21 days old seedling. The three treatments comprised of control (T_0), bavistin (T_1) and bijamrita (T_3) to study the effect of bijamrita and bavistin on cucurbitaceous and leguminous seeds with seven replications each, selecting five plants randomly 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 bijamrita consists of local desi fresh cow urine, cow dung, lime, water and handful soil from the bund of the farm. About 5 kg local cow dung was taken in a cloth and bounded by tape and was submerged in 20 liters of water for 12 hrs. Simultaneously, 50g of slaked lime was dissolved in 1 liters 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 accumulated in water drawn to water phase (cow dung extract). Further, 1 kg of soil was dissolved in cow dung extract by stirring it well. Later on to this, 5 liters of desi cow urine and lime water was added and mixed thoroughly. Finally the seeds were soaked in bijamrita solutions for overnight *i.e.*, 12 hours, afterwards dried in shed and later used for seed germination study.

Preparation of rooting media

The rooting media was prepared using 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 estimation of colony forming units (cfu) through serial dilution plating on a nutrient medium was done by the most widely accepted method for monitoring cultivable bacteria and yeasts in different spheres of microbiology as suggested by Messer *et al*. (2000).

Seed treatment and sowing

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

Seed germination percentage was calculated after seven days by using the formula as reported by Sumithra *et al*. (2006).

$$\text{Germination}(\%) = \frac{\text{no. seeds germinated}}{\text{Total no. of seeds sown for germination}} X100$$

Root length, shoot length, seedling length, root volume and fresh weight

Five seedlings were selected randomly from each replication in each treatment (35 seedlings) after seven days of germination. The root length, shoot length and total seedling length were measured and mean length was calculated at final stage of 21 days old seedlings ready for transplanting. The root volume, fresh weight and seed vigour index were also determined at 21 days old seedling.

Seed vigor index (SVI)

Seed Vigor Index (SVI) was determined by using formula (Abdul and Anderson, 1973) as,

Seed Vigor Index (SVI) = Germination percentage x Seedling length *(i.e.*, Root + Shoot)

Statistical analysis

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

RESULTS AND DISCUSSION

The effect of seed treatments with bijamrita, bavistin and untreated control were studied for seed germination and seedling growth attributes. The bijamrita formulation was analyzed for physico- characteristics and microbial counts which are presented in Table 2. The result revealed that bijamrita has pH (9.5), EC (1.43), nitrogen (40 ppm), phosphorus (155.4 ppm) and potassium (285.50 ppm). The fungal and bacterial colony count present in bijamrita are $0.90 \pm 0.20 \times 105$ cfu/ml and $24.17 \pm 1.04 \times 108$ cfu/ml of sample, respectively.

Seed germination (%)

The effect of seed treatments with bijamrita, bavistin and untreated seeds (control) of cucurbits and leguminous crops are presented in Table 3 and Table 4. The highest germination percentage was observed in seeds treated with bijamrita in comparison to bavistin and control. The maximum germination percentage of 92.5% was recorded in bitter gourd and 88.25% in bottle gourd and cucumber was recorded. Similarly, in leguminous crop, seeds treated with bijamrita showed highest

Table 1: Ingredients used for preparation of bijamrita

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

Table 2: Physico- characteristics and microbial count of bijamrita formulation

Parameters	pH	EC	Nitrogen (ppm)	Phosphorus (ppm)	Potassium (ppm)	Fungal colony (cfu/ml of sample) x 105	Bacterial colony (cfu/ml of sample) x108
Bijamrita	9.5	1.43	40	155.4	285.5	0.90 ± 0.20	24.17 ± 1.04

Table 3: Effect of bijamrita and bavistin treatments on seed germination and seedling growth attributes of major cucurbitaceous crops (21 days old seedlings)

Crop	Treatments	Germination* (%)	Shoot length (cm)	Root length (cm)	Seedling length(cm)	Root volume (cc)	Fresh weight (g)	Seed Vigour Index
Bitter Gourd	Control (T_0)	80.00	9.93	11.07	21.00	1.94	4.11	1633
	Bavistin (T_1)	84.50	10.25	11.65	21.80	2.4	5.78	1819
	Bijamrita (T_2)	92.50	14.45	13.35	27.80	2.56	6.17	2570
SEm ±		1.714	0.68	0.47	1.01	0.11	0.29	121
Cd($p \leq 0.05$)		6.29	2.19	1.73	3.33	1.94	0.73	337
Bottle gourd	Control (T_0)	78.25	13.78	7.58	21.07	2.37	7.78	1219
	Bavistin (T_1)	81.00	15.05	7.98	23.03	2.87	12.54	1934
	Bijamrita (T_2)	88.25	17.35	10.03	27.4	4.45	14.18	2536
SEm ±		1.99	0.673	0.417	0.90	0.28	0.87	121
Cd($p \leq 0.05$)		5.40	2.60	1.42	2.54	0.56	1.87	786
Cucumber	Control (T_0)	78.25	12.90	9.58	22.48	1.74	4.85	1751
	Bavistin (T_1)	81.00	19.00	10.95	29.95	1.94	5.31	2421
	Bijamrita (T_2)	88.25	22.9	12.1	34.35	2.20	6.07	3022
SEm ±		1.93	1.29	1.40	1.57	0.07	0.17	159
Cd($p \leq 0.05$)		5.40	1.63	1.60	1.42	0.22	0.58	338

*Germination (%) was recorded on 7th day

Table 4: Effect of bijamrita and bavistin treatments on seed germination and seedling growth attributes of major leguminous crops (21 days old seedlings)

Crop	Treatments	Germination* (%)	Shoot length (cm)	Root length (cm)	Seedling length(cm)	Root volume (cc)	Fresh weight (g)	Seed Vigour Index
Black Gram	Control (T_0)	64.50	11.73	5.88	17.60	0.79	0.97	1137
	Bavistin (T_1)	71.00	13.25	7.48	20.62	1.10	1.37	1460
	Bijamrita (T_2)	81.50	14.93	8.10	23.02	1.30	1.83	18840
SE ±		2.50	0.50	0.37	0.77	0.07	0.12	101
Cd(0.05)		6.34	1.26	1.70	1.85	0.20	0.29	386
Cow Pea	Control (T_0)	60.50	15.70	11.45	27.15	1.78	3.10	1645
	Bavistin (T_1)	62.50	19.70	12.98	32.68	2.16	5.15	2040
	Bijamrita (T_2)	72.00	24.38	14.98	39.35	2.56	8.56	2838
SEm ±		2.55	1.17	0.57	1.65	0.45	0.69	174
Cd($p \leq 0.05$)		6.19	2.83	1.36	3.12	0.44	0.50	500
Vegetable Soybean	Control (T_0)	67.50	19.00	12.9	27.15	2.98	4.96	2152
	Bavistin (T_1)	72.50	22.9	13.35	33.93	3.15	4.96	2621
	Bijamrita (T_2)	84.00	25.77	16.10	40.00	6.70	7.60	3525
SEm ±		2.61	0.93	0.54	1.32	0.52	0.35	186
Cd($p \leq 0.05$)		8.57	4.68	2.05	2.34	0.60	0.38	778

*Germination (%) was recorded on 7th day

germination percentage. Maximum germination percentage was recorded in black gram (81.50%), cow pea (72.00%) and vegetable soybean (84%) in bijamrita treated seeds. Seed germination percentage in bijamrita treated seeds was significantly higher than the seed germination percentage of other treatments. Higher germination percentage in bijamrita treated seeds might be due to the presence of useful bacteria in bijamrita, producing indole acetic acid (IAA) and gibberellic acid (GA) as reported in earlier findings by Sreenivasa *et al.* (2009) and Shakuntala *et al*. (2012). Bijamrita seed treatment also recorded higher germination (Subramaniyan and Malliga, 2016) and amylase enzyme activity compared to seed soaked in water and was witnessed by Shakuntala *et al*. (2012). Karuppaswamy and Perumal (2013) also reported the equal combination of bijamrita (25%) and cyanospray (0.3%) showed better result than other treatments of seed germination. 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). Similarly, Pandit *et al*. (2016) also reported seed soaking of chickpea in vermiwash for 8 hours under dry land conditions resulted in early emergence. The growing media *i.e.*, Cocopeat + Vermicompost also has beneficial effect on seed germination and seedling establishment in papaya(Nagar *et al*., 2016).

Shoot length, root length, seedling length, root volume and fresh weight

The growth attributes of different treated seeds for shoot length,

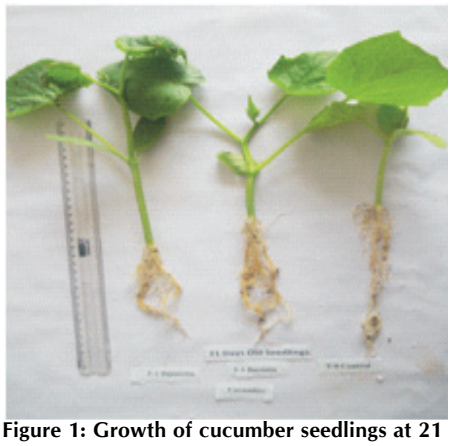

Figure 1: Growth of cucumber seedlings at 21 DAS under different seed treatments

Figure 2: Growth of bitter gourd seedlings at 21 DAS under different seed treatments

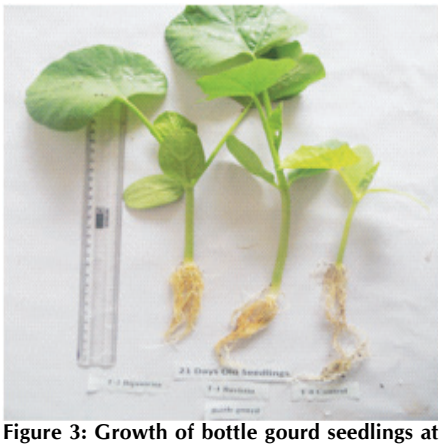

Figure 3: Growth of bottle gourd seedlings at 21 DAS under different seed treatments

Figure 4: Growth of cow pea seedlings at 21 DAS under different seed treatments

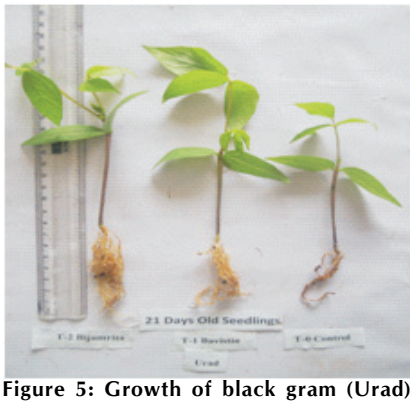

Figure 5: Growth of black gram (Urad) seedlings at 21 DAS under different seed treatments

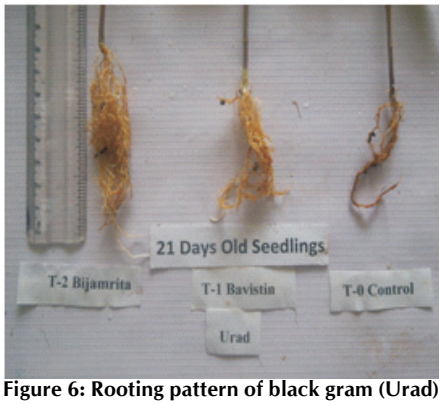

Figure 6: Rooting pattern of black gram (Urad) seedlings at 21 DAS under different seed treatments

root length, seedling length, root volume and fresh weight of seedling was recorded at final stage of 21 days after seed sowing and results obtained are presented inTable 3 and Table 4. The organic treatments performed better results than the chemical and control as shown in Fig. 1, 2 and 3 in cucurbits. The maximum shoot length, root length, seedling length, root volume and fresh weight were observed in bijamrita (T_2) treated seeds followed by bavistin (T_1) and least in untreated seeds (T_0). The maximum shoot length of bitter gourd, bottle gourd and cucumber was 14.45, 17.35 and 22.90 cm, respectively and found significantly higher in comparison to other treatments. Similarly, significantly highest shoot length was observed in black gram (14.93 cm), cow pea (24.38 cm) and vegetable soybean (25.77 cm) under legumes. 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. A similar finding was also reported by Sreenivasa *et al*. (2009).

The bitter gourd, bottle gourd and cucumber recorded maximum seedling length of 27.80, 27.4 and 34.35 cm, respectively in bijamrita treated seeds. Similar trend in seedling length was also observed as 23.02 cm in black gram (Fig. 4), 39.35 cm in cow pea (Fig. 5) and 40.00 cm in vegetable soybean . Moreover, the root length and root volume was recorded maximum in c bijamrita treated seeds in both cucurbitaceous and leguminous crops. The rooting pattern of bijamrita treated seed in black gram at 21 days old seedlings are depicted in Fig. 6.

The maximum root length and root volume in bitter gourd (13.35 cm and 2.56 cc), bottle gourd (10.03 cm and 4.45 cc) and cucumber (12.10 cm and 2.20 cc) was recorded in bijamrita treated seeds compared to other treatments. In legumes, similar results in black gram (8.10 cm and 1.30 cc), cow pea (14.98 cm and 2.56 cc) and vegetable soybean (16.10 cm and 6.70 cc) were recorded and found significantly higher than bavistin and control. The fresh weight of seedling was also found highest in bijamrita treated seeds where the maximum fresh weight was recorded in bitter gourd (6.17 g), bottle gourd (14.18 g) and cucumber (6.07 g). In legumes, black gram, cow pea and vegetable soybean also showed significantly higher fresh weight of 1.83, 8.56 and 7.60g, respectively.

The result of bijamrita treatment showed significant effect on 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). A similar finding was also reported by Nagaraja (2009) who observed better growth of chilli in bijamrita treated

seeds compared to other treatments.

Seed vigour index (SVI)

The Seed Vigour Index (SVI) was found better in bijamrita treated seeds (Table 3 and 4). In cucurbits, bitter gourd, bottle gourd and cucumber recorded significantly highest seed vigour index (SVI) of 2570, 2536 and 3022, respectively. Similarly in legumes, bijamrita treated seed showed significantly highest seed vigour index (SVI) of 1884, 2838 and 3525 in black gram, cow pea and vegetable soybean, 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 were also reported by Devakumar *et al*. (2014) who observed that jivamrita and bijamrita mobilize more of plant nutrients and provide plant growth promoting substances and also 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 are known to protect the crop against harmful soil and seed pathogens. Bacteria isolated from bijamrita were capable of N_2-fixation, P-solubilization, and growth hormone (IAA, GA) production in addition to suppression of Sclerotium (Sreenivasa *et al*., 2009).

The presence of beneficial microorganisms in bijamrita and jivamrita might be due to their constituents such as cow dung, cow urine, legume flour and jaggery containing both macro, and essential micro nutrients, many vitamins, essential amino acids, growth promoting substances like IAA and GA (Palekar, 2006; Sreenivasa *et al*., 2010). Jivamrita and panchagavya have enhanced the growth of nitrogen fixers in locally available substrates such as press mud, compost and digested biogas slurry (Devakumar *et al*., 2011) and a greater number of beneficial microorganisms were reported in panchagavya under higher acidity. These microorganisms secrete proteins, organic acids and antioxidants in the presence of organic matter and convert them into energy thereby the soil micro flora and fauna change a disease inducing soil to a disease suppressive soil (Somasundaram *et al*., 2003).

The reason behind the better performance of bijamrita treatment might be due to the micro organisms associated with it. The present findings are in conformity with Swaminathan (2005) who reported 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. Moreover, 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). These findings are in support of Karuppaswamy and Perumal (2013) who stated that seed germination and seedling development are well regulated process in plant physiology involving high metabolic activity. The germination of seeds involves a rise in general metabolic activity and initiates the formation of a seedling from the embryo (Subramaniyan and Malliga, 2016). The water is absorbed by seeds and enzymes such as lipases, proteinases, phosphatases and hydrolases which 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). The maximum colonies of bacteria, fungi, actinomycets, N-fixers and P-solubilizers were present in bijamrita on the day of preparation and later it gets declined gradually in their number as the days elapsed (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).

The bijamrita made from locally available ingredients are useful to increase the seed germination percentage, seedling growth and seed vigour index. The result revealed an application of bijamrita on seed treatment of bitter gourd, bottle gourd and cucumber and among legume seeds black gram, cow pea and vegetable soybean showed significantly better results in comparison to 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 needed to analyze the penetration and translocation of ingredients present in bijamrita treated seeds and activated processes resulting in better efficacy on seed germination and seedling growth attributes. The expenditure incurred on production of bijamrita is very less as it is prepared from locally available ingredients. Its regular use for seed treatment will reduce the use of chemicals and subsequently reduces the pollution caused by chemicals. Hence, the use of bijamrita as seed treatment must be popularized on larger scale instead of using inorganic chemicals.

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