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Short communication

Effect of herbal *kunapajala,* traditional liquid manure, on germination and seedling vigour of chickpea (*Cicer arietinum* L.)

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Chickpea (*Cicer arietinum* L.), belonging to the family *fabaceae,* is a cool season pulse crop and widely cultivated in India. Crop establishment is major concern for better crop productivity. Poor quality seed, low temperature stress and lack of soil moisture lead to poor crop emergence and sparse plant stands. Therefore, seed priming, a most promising seed invigoration technique, can be used to hasten germination, enhancecrop establishment and promote seedling vigour. Hydropriming is a simple, environmental friendly and economical method of seed priming which includes overnight soaking of seed followed by drying before sowing. Seed priming with liquid organic concoctionlike *kunapajala, panchyagavya*was also reported byKumar*et al*. (2020). *Kunapajala* is liquid fermented organic manure made from animal waste containing animal flesh, dung, urine, bones, marrow and skins (non-herbal *kunapajala*) or the plant products (herbal *kunapajala*). *Kunapajala* is mainly used as foliar nutrition (Sudhakar *et al*., 2010), soil drenching and priming medium for many agricultural and horticultural crops because of having biostimulant, nutrition and antimicrobial properties. This liquid organic concoction contains macro and micro nutrients(Ankad*et al*., 2017), vitamins, growth regulators like IAA and GA_3, essential amino acids (Sudhakar *et al*., 2010)and beneficial microbes like *Rhizobium, Azotobacter, Azospirillum*, phosphorus solubilizing bacteria, *Trichoderma* and *Pseudomonas*. Information regarding the use of liquidmanure for seed treatment is meagre. Hence, the present study was carried out to evaluate the effect of herbal *kunapajala,* a traditional liquid manure, on germination and seedling vigour of chickpea.

The laboratory study was conducted at seed physiology laboratory, Department of Agronomy, College of Agriculture, G. B. Pant University of Agriculture and Technology, Pantnagar (29°1' N latitude, 79°29'E longitude, elevation of 231 m above mean sea level) during rabi season of 2020-21 and laid out in completely randomized design with five treatments and six replications. The seeds of desi chickpea cultivar, Pant Gram-5 were treated with different concentration of herbal *kunapajala* viz, 10%, 25% and 50% along with hydropriming (tap water) and control treatment (no priming) for 8 h in ratio of 1:2 (seed: priming media) (w/v) followed by shade drying to reach initial moisture content. For determination of water imbibition rate and α-amylase activity, seeds are soaked in different priming media for 8, 12, 16 and 24 h and 8, 16 and 24 h, respectively.

The standard germination test was determined by following the method of ISTA (2004). Physiological parameters i.e., germination % (Kala *et al.,* 2019) at 8th day, speed of germination (Maguire, 1962), mean germination time (Ellis and Robert, 1981),root length, shoot length and seedling dry weight, seedling vigour index-I & II (Abdul-Baki and Anderson, 1973), seed metabolic efficiency (Sikder *et al*., 2009) at 5th and 8th days after incubation and biochemical parameter like the α-amylase activity of chickpea seeds (Mazumdar and Majumder, 2017), were evaluated. The rate of water imbibition was calculated by method given by Tian *et al*. (2014) with modification. The collected experimental data from laboratory experiment was analyzed using standard techniques of Analysis of Variance (ANOVA) for completely randomized design (CRD). The critical difference was calculated at 5% level of probability.

Data (Table 1) showed that priming with 10% herbal *kunapajala* being at par with hydropriming (87.3%), recorded significantly

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higher germination percentage (90.7%) than rest of the treatments whereas the highest speed of germination was recorded from priming with 10%herbal *kunapajala* (22.9 per day). Similarly, priming with 10% herbal *kunapajala* showed the lowest mean germination time (1.17 days) which remained at par with hydropriming (1.63 days). However, seed priming with 50% *kunapajala* recorded the lowest germination percentage and speed of germination (70.7% and 8 per day, respectively) whereas 50% *kunapajala* priming resulted into the highest mean germination time (3.3 days). The improvement in seed germination percentage of chickpea might be due to the action of beneficial microorganisms, amino acids, vitamins and growth regulators like IAA and GA_3 present in herbal *kunapajala* concoction (Sudhakar *et al*., 2010). Gibberellin is produced in the seeds and induced the production of α-amylase which resulted in hydrolysis of endosperm starch and supply energy for germination. Similar findings are reported by Ankad*et al.* (2017) and Kala *et al*. (2019). The improved speed of germination under priming with 10% *kunapajala* and hydropriming attributed to quick commencement in enzymatic activities and rapid breakdown of and mobilization of seed reserves through enhanced α-amylase activity which directly decreased the mean germination time of primed seeds. The reduction in germination indices with higher concentration of *kunapajala* was due to negative impact of germination inhibitory material on GA_3 synthesis in embryo which consequently effected the starch hydrolysis and seed germination. Those results are in supporting of Srimathi *et al*. (2013).

Table 1: Effect of different seed invigoration treatments on germination indices and seedling vigour parameters of chickpea

Treatments	G %	SOG	MGT	SHL	RTL	SDL	SDW	SVI-I	SVI-II
No priming	78.0	14.1	2.2	3.25	4.3	7.5	16.8	587	1312
Hydropriming	87.3	18.2	1.6	4.53	7.6	12.1	19.9	1057	1735
10% KJ priming	90.7	22.9	1.2	5.45	10.6	16.1	21.9	1459	1981
25% KJ priming	86.0	11.2	2.4	3.57	4.7	8.3	17.8	713	1528
50% KJ priming	70.7	8.0	3.3	3.09	3.1	6.2	15.4	435	1090
SEm±	1.6	1.2	0.2	0.19	0.2	0.3	0.5	24	64
CD (p=0.05)	4.6	3.4	0.6	0.60	0.6	1.0	1.5	78	204

KJ: Kunapajala; G: Germination; SOG: Speed of germination (seedlings/day); MGT: Mean germination time (days); SHL: Shoot length (cm/seedling); RTL: Root length (cm/seedling); SDL: Seedling length (cm/seedling); SDW: Seedling dry weight (mg/seedling); SVI-I: Seedling vigour index-I; SVI-II: Seedling vigour index- II

Seed priming with 10% herbal *kunapajala* significantly increased shoot length, root length, seedling length, seedling dry weight and SVI- I and SVI- II (5.45 cm, 10.6 cm, 16.1 cm, 21.9 mg, 1459 and 1981, respectively) over remained treatments (Table 1). The minimum shoot length, root length, seedling length, seedling dry weight and SVI- I and SVI- II (3.09 cm, 3.1 cm, 6.2 cm, 15.4 mg, 435 and 1090, respectively) were recorded from priming with 50% *kunapajala* which was at par with no priming in respect of shoot length and seedling dry weight. Pre-sowing seed priming improved germination and seedling vigour which resulted into superior development than untreated seeds. The increment in seedling growth and seedling vigour index through seed priming with traditional liquid organics was also observed by Kala *et al.* (2019). However, the reduction in seedling growth due to increased concentration levels of *kunapajala*was also confirmed by Kumar*et al*. (2020).

Water imbibition rate of chickpea varied significantly due to different seed priming treatments and priming durations up to 12 h of soaking (Table 2). At 8 h of priming, significantly higher water imbibition rate was observed from priming with 10% herbal *kunapajala* (36.6 mg/g dry seed/h) than rest of the treatments, but remained at par with hydropriming and 25% herbal *kunapajala* priming. The lowest water imbibition rate was recorded from priming with 50% herbal *kunapajala* (18.1 mg/g dry seed/h) which was statistically similar with control. At 12 h of priming, highest water imbibition rate was recorded from priming with 10% herbal *kunapajala* (21.5 mg/g dry seed/h) which was at par with hydropriming. Priming with 50% herbal *kunapajala,* beingat par with 25% herbal *kunapajala* and control, showed lowest water imbibition rate (15.8 mg/g dry seed/h). The faster imbibition rate during initial h as compared to subsequent durations, was observed as protein is strong absorber of water. Solutes produced as results of α-amylase activity enhanced the water movement into the seeds by contributing to seed osmotic potential. Moreover, increased roughness in seed coat of primed seeds enhanced the water uptake than unprimed seeds. Improvement in hydrophilic property of seed due to altered seed coat ultimately enhanced water uptake of seed (Ling *et al*., 2014). Similar trend was observed byBormashenko*et al*. (2012) and Ling *et al*. (2014). The decline in water uptake with increasing *kunapajala* concentration might be due to deposition of inhibitory hydrophobic products.

Table 2: Effect of different seed invigoration treatments on water imbibition rate, seed metabolic efficiency and α-amylase activity of chickpea

Treatments	Water imbibition rate (mg/g dry seed/h)				Seed metabolic efficiency (g/g)		α-amylase activity (mg of starch hydrolyzed/g of seeds)		
	8 hours	12 hours	16 hours	24 hours	5th DAI	8th DAI	8 hours	16 hours	24 hours
No priming	26.3	16.7	10.8	1.39	0.306	0.394	16.7	16.7	16.7
Hydropriming	35.5	19.6	14.0	3.14	0.381	0.468	27.0	24.7	21.4
10% KJ priming	36.6	21.5	15.5	2.75	0.519	0.622	28.8	26.6	24.8
25% KJ priming	30.4	15.9	14.5	2.18	0.341	0.452	17.7	15.8	13.7
50% KJ priming	18.1	15.8	10.3	1.82	0.270	0.343	13.5	11.6	11.0
SEm±	3.3	1.2	1.4	0.62	0.02	0.034	0.7	1.0	0.7
CD (p=0.05)	10.1	3.7	NS	NS	0.066	0.108	2.3	3.0	2.2

KJ: *Kunapajala*; DAI: Day after incubation; NS: Non-signifiant

Seed metabolic efficiency is a measurement of translocation of food reserve from endosperm to growing parts of seedlings. At 5th and 8th day after incubation (DAI) (Table 2), priming with 10% herbal *kunapajala* showed significantly higher seed metabolic efficiency (0.519 and 0.622 g/g, respectively) than rest of the priming treatments. However, 50% herbal *kunapajala,* being at par with non-primed seeds (0.306 and 0.394 g/g, respectively) showed the lowest seed metabolic efficiency (0.270 and 0.343 g/g, respectively) at 5th and 8th DAI which could be resulted from less water uptake by seed and decrease in gibberellic acid and other hydrolytic enzymes during germination process. Rapid accumulation of germination metabolites and metabolic repair due to priming promotes quick translocation and supply of food reserve to developing seedlings (Farooq *et al*., 2019). Similar result was reported by Pal *et al*. (2017).

Perusal of data (Table 2) revealed that α-amylase activity of chickpea was significantly influenced by both seed invigoration treatments and priming durations. The α-amylase activity increased up to 8 h of priming duration and after that it reduced gradually. At 8 and 16 h of priming, significantly higher α-amylase activity was observed from priming with 10% herbal *kunapajala* (28.8 and 26.6 mg of starch hydrolyzed/g of seeds, respectively) than rest of the priming treatments, but was at par with hydropriming whereas at 24 h of priming, the highest α-amylase activity was observed from priming with 10% herbal *kunapajala* (24.8 mg of starch hydrolyzed/g of seeds). However, 50% herbal *kunapajala* primed seeds showed minimum α-amylase activity at 8, 12 and 16 h of priming durations (13.5, 11.6 and 11.0 mg of starch hydrolyzed/g of seeds, respectively) among all the priming treatments. Enhancement of α-amylase activity in primed seeds resulted from proper imbibition that increased starch hydrolysis and breakdown into soluble sugars. The expression of *RAmy1A* is triggered by transported GA_3 and induced α-amylase activity in endosperm (Kaneko *et al*., 2002). The presence of amino acids, vitamins and growth regulators like IAA and GA_3 in *kunapajala* was reported bySudhakar *et al*. (2010).Similar findings were also reported by Farooq *et al.* (2019). However, reduction in α-amylase activity observed with higher *kunapajala* concentration and priming duration attributed to negative impact on GA_3 synthesis in embryo which consequently effected the starch hydrolysis and seed germination.

Based on the findings of the study, it can be concluded that seed invigoration with 10% herbal *kunapajala* was the most effective method over no priming and hydropriming to improve seedling vigour parameters of chickpea. However, hydropriming and 10% herbal *kunapajala* priming seems to enhance germination and enzymatic activity significantly over no priming.

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