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Performance of hydrogel on seed germination and growth of young coffee seedlings in nursery

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Abstract
An investigation was carried out to study the performance of hydrogel on seed germination and growth of young coffee seedlings in nursery at Central Coffee Research Institute, coffee Research Station, Balehonnur, Karnataka, during the year 2017-18. Results revealed that, nursery bed without gel achieved higher percent of seed germination (90 %) and was taken less number of days (35) to 50 % germination. Among the growth parameters, control recorded significantly maximum plant height (40 cm), number of leaves per plant (14), stem girth (0.51cm), total nodes per plant (7) and shoot dry matter partitioning (11gm) and the parameters like tap root length, root volume and root dry matter partitioning (29 cm, 9 cc/gm and 3 gm, respectively) was significantly higher in treatment T_2 (1 gm gel per polybag. Hence, ash treatment (control) is the best and effective method to improve the germination and growth of young coffee seedlings.

Keywords: coffee seedlings, hydrogel, nursery, polybag, root parameters and seed germination

Introduction
Coffee is primarily cultivated as a rainfed crop worldwide and planting of coffee on steep hill sloppy regions with lack of supplementary irrigation and application of nutrients, cause gradual decrease in their productivity. In the coffee tracts of South India, the South-West monsoon provides more than 60% rain and rest is from North-East monsoon. The dry period usually consists of 4-5 months from November onwards. The most important factor which limits the establishment and production of coffee even in well managed estates is the long dry period. In addition, irregular monsoon and changing climatic condition are the major constraints in coffee production in India. These constraints are expected to become increasingly important in several coffee growing regions due to the climatic fluctuation and water shortage. Implementation of proper water management practices such as micro-irrigation, fertigation, supplementation of super absorbent polymers (SAPs) etc., are considered as best ways to manage moisture stress during the drought period to improve soil moisture and water holding capacity of soil in coffee growing estates.

Recently, SAPs are used in agriculture as a soil additive, as reservoir of water and nutrients in the soil to encounter the impacts of dehydration and reduce impacts of moisture stress in crops. As it absorbs water hundreds times of its own weight and being converted to long lasting gels, have a special place in agriculture, erosion control and runoff reduction in steep slope areas. These compounds improve the performance of some types of fertilizers and also enhance the activities of soil microorganisms. Research evidences suggest that problems associated with traditional micro- irrigation and irrigation techniques can be reduced by the application of polymers without compromising the crop yield (Oraee *et al*., 2013 and Barakat *et al*., 2015) [2, 1]. Application of 1.5 liters of polymer solution (composed of 1.5 kg of polymer diluted in 400 liters of water) at the time of new planting can reduce the mortality of coffee plants in the main field. (Pieve *et al*., 2013) [4]. Another investigation revealed that application of 100 gm absorbent recorded significantly higher yield of *Citrus limon* and increased the water holding capacity of the soil from 28.74 to 34.63 per cent. The increased yield might be due to the fact that the soil was wet for a longer time which enhanced the microbial activity as well as reducing the fruit drop due to water stress. It was also observed that absorbent was able to retain available water for the plant up to fifteen days after irrigation (Pattanaaik *et al*., 2015) [3]. Studies pertaining to the application of hydrogel in coffee plantation had not been attempted in this region. Hence, keeping in view the above facts, investigation was carried out to evaluate the performance of hydrogel on seed germination and growth of young coffee seedlings in the nursery.

Material and Methods

The present investigation was carried out during the year 2017-18, to study the performance of hydrogel on seed germination and growth of young coffee seedlings in nursery at Central Coffee Research Institute, Coffee Research Station, Balehonnur, Karnataka. During the experiment two nursery beds were raised with a dimension of one meter in length, one meter in breadth and 15cm in height. Before sowing the seeds, one bed was treated with hydrogel at the rate of 25 gm per square meter area and another bed was treated without hydrogel (control). The bed which was treated with hydrogel was irrigated once in 3 days, whereas the bed without hydrogel was irrigated daily (either morning or evening). Observations on total number of seeds germinated and number of seeds to 50% germination was recorded.

Further, 45 days old nursery seedlings (seedlings treated with and without gel in the nursery bed) were selected separately and transplanted into the polybags as per the treatments. The experiment was laid out in Randomized Block Design (RCBD) comprising of four levels of hydrogel treatments with four replications. The treatment details is as given below.

Treatments	Hydrogel levels
T_1	Control (without hydrogel)
T_2	1 g/ Poly bag (Seedling)
T_3	2 g/ Poly bag (Seedling)
T_4	3 g/ Poly bag (Seedling)

Before transplanting of coffee seedlings (Topy stage) into the polybags, the polybags weighing approximately one kg were filled with soil, sand and FYM with a ratio of 5:2:1 and were applied with the calculated quantity of hydrogel as per the treatments. The 45 days old coffee seedlings from non treated nursery bed were transplanted into the polybags, containing no gel (control or without hydrogel) and the seedlings of treated nursery bed were pulled off separately and transplanted into the polybags containing various levels of hydrogel (1gm, 2gm and 3gm). The polybags which contains no gel were irrigated daily once and the polybags treated with 1gm, 2gm and 3gm of hydrogel were irrigated alternate day, once in two days and once in three days, respectively. Observations on shoot and root parameters were recorded through destructive method of sampling.

The data collected on different parameters were subjected to s tatistical analysis.

Results and Discussion

Data pertaining to the performance of hydrogel on number of seeds germinated are depicted in Figure 1. Results showed that, seeds treated with hydrogel did not show influence on number of seeds germinated. However, the treatment control recorded higher number of seed germination (324) whereas, the less number of were germinated (313) in the treatment supplemented with hydrogel compared to control.

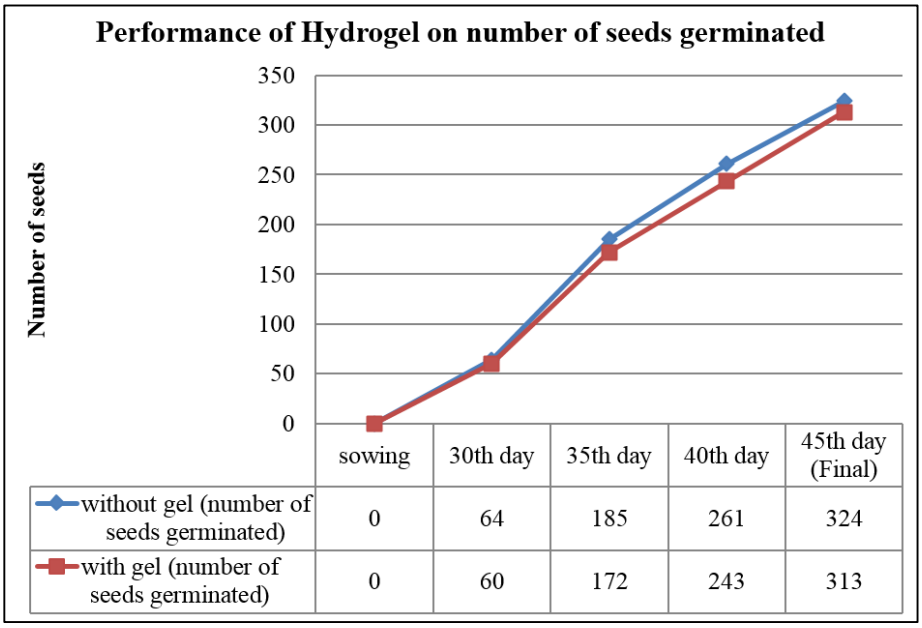

Fig 1: Performance of hydrogel on number of seeds germinated

The results pertaining to the percent seed germination due to performance of hydrogel are illustrated in Figure 2. At 45 days after sowing the application of hydrogel had not showed influence on percent seed germination. The maximum percentage of seed germination (90 %) was observed in control (without hydrogel) and the treatment was taken less number of days (35) to achieve 50 % seed germination. Whereas the treatment with hydrogel application shown minimum percentage of seed germination (86.9 %) and was took more number of days (40) to achieve 50% seed germination. Maximum number of seeds germinated and higher germination percentage in the treatment control (without hydrogel) could be attributed to the presence of ash covering seed coat helps in retaining and maintaining the moisture content of the bean with proper aeration in the bed throughout the germination phase, which enhanced the metabolic activity and triggers the germination process, results in earlier and better germination was achieved.

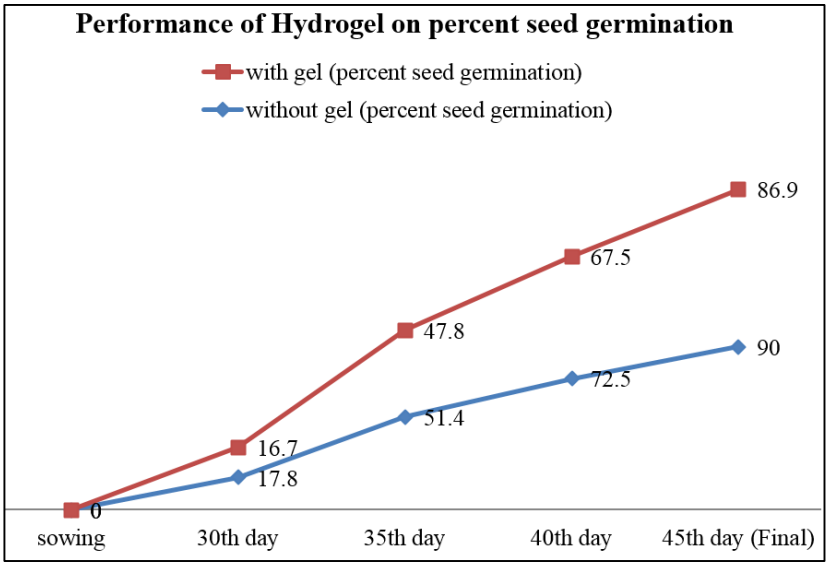

Fig 2: Performance of hydrogel on percent seed germination

Data on performance of hydrogel on shoot and root parameters of young coffee seedlings (Eight months old) are depicted in Table 3. Results showed that, all the growth parameters were significantly influenced by different levels of hydrogel on young coffee seedlings in the nursery. Among the different treatments, treatment T_1 (control) recorded significantly maximum plant height (40 cm), number of leaves per plant (14), stem girth (0.51cm), total nodes per plant (7) and shoot dry matter partitioning (11gm), which was on par with T_2 (1 gm gel per polybag) with respect to stem girth (0.51 cm). Whereas, minimum plant height, number of leaves per plant, stem girth, total nodes per plant, tap root length, root volume and shoot and root dry matter partitioning (18 cm, 10, 0.40 cm, 5, 19cm, 6 cc/gm, 4 gm and 1gm, respectively) was observed in treatment T_4 (3gm gel per polybag).

However, the parameters like tap root length, root volume and root dry matter partitioning (29 cm, 9 cc/gm and 3 gm, respectively) was significantly higher in treatment T_2 (1 gm gel per polybag), which was found on par with treatment T_3 (2 gm gel per polybag) with respect to tap root length and root volume (28 cm and 7 cc/gm, respectively). Increasing levels of hydrogel has a negative effect on the growth of young coffee seedlings in the nursery for height, number of leaves per plant, stem girth, total nodes per plant and shoot dry matter partitioning. This might be due to the fact that, hydrogel also absorbs water and fills the soil pores causing flooding in the polythene tubes therefore retards the growth and growth parameters of young coffee seedlings. This finding was in agreement with (Cheruiyot Gilbert *et al*., 2014) [5].

Table 3: Performance of hydrogel on shoot and root parameters of young coffee seedlings (Eight months old)

Treatments	Plant height (cm)	Number of leaves per plant	Stem girth (cm)	Total nodes per plant	Tap root length (cm)	Root volume (cc/gm)	Dry matter partitioning (gm)	
							Shoot	Root
T1	40	14	0.51	7	26	6	11	2
T2	35	12	0.51	6	29	9	8	3
T3	27	12	0.44	6	28	7	6	2
T4	18	10	0.40	5	19	6	4	1
SEm±	1.3	0.3	0.0	0.2	0.8	0.7	0.6	0.2
CD(0.05)	3.9	0.8	0.1	0.5	2.3	2.0	1.8	0.5

Conclusion

Application of hydrogel did not show performance on seed germination, percent seed germination and shoot and root parameters of young coffee seedlings (8 months old) in the nursery. Hence, it could be conclude that, the treatment control (ash treatment) is the easy and cost effective method to improve the germination and growth of young coffee seedlings in the nursery.

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