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Effect of *Xanthan gum* seed coating on seed germination and seedling vigour of finger millet (*Eleusine coracana* L.)

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ABSTRACT

Six Hydrophilic polymers *Xanthan* Gum, *Iota Carrageenan*, *Kappa Carrageenan*, *Agar Agar*, Food grade *Agar* and *Gellan Gum* were studied for polymerization potential and water holding capacities. Among the six polymers, *Xanthan gum* and *Iota Carageenan* recorded the maximum values for water holding capacities of 38.27 ml/g and 34.17 ml/g and were forwarded for the Seed coating experiment. Coating experiments consist of twodosages of polymer powders (10g, and 20g /kg) and two concentrations of sticking agent (water 5ml and 10 ml). Coated seeds exposed to seed germination studies against untreated seeds. Results revealed that Finger millet seeds coated with 20 g Xanthan gum + 10 ml water as sticker recorded the maximum values for seed germination (87%), seedling length (26.23cm), dry matter production (12.47mg 10 seedlings^{-1})and Vigour Index I (2282) and II (1084).The % increase over the control was 7 for seed germination, 56 for seedling length (cm), 21 for dry matter production (mg) ,69 for seedling vigour index I and 31for seedling vigour index II. From the studies it could be concluded that Finger millet seeds coated with the *Xanthangum* @20 g can be recommended as pre sowing seed treatment for improving the Seed Germination and seedling vigour.

Introduction

Finger millet (*Eleusine coracana* L.) is one of the important minor millets, extensively cultivated in India with a total area of 2.5 million hectares producing 2.2 million tonnes. It is a rich source for Ca (300-350mg/100g), P(283 mg/100g) and Fe (3.9 g/100g),vitamin B_1, B_2, folic acid and niacin.Millets are adapted to a wide range of Soils.It does not demand rich soils for growth. Nowadays, the area under millet cultivation is continuously declining, that too the crop is majorly cultivated in rainfed /drought prone ecosystems in India. The productivity and profitability of millets cultivation is also affected due to absence of quality seed supply chain and improper crop management. It is a high timeto develop and enhance the productivity of rainfed crops by using the quality seeds and adopting technological interventions to mitigate water stress. Technological intervention to overcome drought stress during seed germination paving way to adequate crop stand could help to increase the productivity and expand millets cultivation in rain fed areas. Hydrophilic polymers has great potential in restoration and reclamation and can hold 400 – 1500 g of water /g (Akther *et al.,*(2004),Mikkelsen*et al*., (2016)). In ideal situations they can store and provide 95% water for plant absorption (Johnson and Veltkamp, 1985). Blodgett *et.al.,* (1993) found that adding superabsorbent polymers to the soil matrix increased the water holding capacity and also increased the water availability to plants. The superabsorbent polymers also prolonged water availability for plant use when irrigation stopped (Huttermann*et al.,*1999, Abobatta*et al.,* (2018)).

Xanthan gum an excellent hydrophilic polysaccharide, though soil application *Xanthan gum* could improve the soil properties

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(Dehghan *et al*., 2019 and Soldo *et al*., 2020). Nevertheless, studies on organic hydrophilic polymers application through seed coating is very scanty or nil. By seed coating the quantity of polymer required can be minimized and also the labour and time required for field application can be reduced. With this background the present study was initiated in Finger Millet.

Material and Methods

Six organic Hydrophilic polymers namely *Xanthan Gum, Iota Carrageenan, Kappa Carrageenan, Agar Agar,* Food grade *Agar* and *Gellan Gum* were collected from the market. The Finger Millet seeds (ATL 1) with 80 % germination and 12 % moisture was used as the base material for the study. The studies were carried out at Agricultural College and Research Institute, Kudumiyanmalai, Pudukkottai, Tamil Nadu during 2022. Organic hydrophilic polymers exposed for polymerization potential and water holding capacities.

Seed coating

The Finger Millet seeds were coated with different dosages of hydrophilic polymer dry powders (*viz.,*10 g and 20 g /kg of seeds) with various dosages of water as sticker (*viz.,* 5ml and 10 ml) and exposed to seed germination studies under lab conditions against the uncoated seeds (Table 1.).

Seed Germination

Germination test in quadruplicate using 25 seeds each with 4 replications was carried out in sand method with 60 % WHC of substrata. Test conditions of 25 ± 2ºC and 95 ± 3% RH were maintained in the germination room. At the end of 8 days the number of normal seedlings were counted and the mean expressed as Percentage (ISTA, 2009).

Root length (cm)

Root length of all the normal seedlings from the germination test was measured from collar region to the root tip and the mean expressed in cm.

Shoot length (cm)

Shoot length of all the normal seedlings from the germination test will be measured from collar region to the shoot apex and the mean will be expressed in (cm).

Dry matter production (mg 10 seedlings^{-1})

The seedlings used for growth measurement were shade dried for 24h (after removing the cotyledons) and dried again in a hot Air oven maintained at 85 ± 2^{0}C for 24 h and cooled in a silica gel desiccator for 30 min. The dry weight of seedlings were recorded using an electronic balance and results expressed in mg 10 seedlings^{-1}.

Vigour Index I

Vigour index I values were computed using the following and the mean values were expressed in whole number.

Vigour index I = Germination (%) x total seedling length (cm)

Vigour index II

Vigour index II values were computed using the following formulaand the mean values were expressed in whole number.

Vigour index II = Germination (%) x Dry matter production (g / 10 seedlings)

(Maya *et al.,*2016 reported that).

Table 1. Treatment details

T_0	:	Untreated seeds
T_1	:	10gm Xanthan gum + 5 ml water as sticker / kg of seeds
T_2	:	10gm Xanthan gum + 10ml water as sticker/ kg of seeds
T_3	:	20gm Xanthan gum + 5 ml water as sticker / kg of seeds
T_4	:	20gm Xanthan gum + 10ml water as sticker/ kg of seeds
T_5	:	10gm Iota Carrageenan+ 5 ml water as sticker / kg of seeds
T_6	:	10gmIota Carrageenan+ 10ml water as sticker/ kg of seeds
T_7	:	20gm Iota Carrageenan+ 5 ml water as sticker / kg of seeds
T_8	:	20gmIota Carrageenan+ 10ml water as sticker/ kg of seeds

Results and Discussion

Among the six hydrophilic polymers the polymerization potential and water holding capacities were recorded maximum in *Xanthan gum*38.27 ml/g (3727times) of polymer and in *Iota Carrageenan*34.17ml/g(3317 times) of water absorption than the control ml/g of polymer.The results were in agreement with Mikkelsen (2016), they reported that the hydrolyzedstarch-graft-polyacrylonitrile or H-SPAN polymer can absorb up to 2000 times their weight.*Xanthan gum*and *Iota Carrageenan*were taken for the seed coating experiments. The hydrophilic polymers coating increased the seed germination and seedling vigour of Finger millet. The seeds coated with *Xanthan Gum* (20 g) + Water (10ml) /kg of seeds as sticking agent recorded the maximum values for seed quality parameters. The values recorded were 87%, 26.23cm, 12.47 mg 2282 and 1084 respectively for germination, Seedling length and vigour index I &II. This was followed by the seed coated with *Iota Carrageenan* 20 g + 10ml Water /kg of seeds (85 %, 25.51cm ,11.76mg, 2168 and 999) and control recorded the minimum values of 80%,16.86cm ,10.29mg,1348 and 823 for germination %, Seedling length, dry matter production, Vigour Index I and II. Polymer coatings on seeds provide more efficient imbibitions of water, speed up germination and improved seedling growth. The % Increase over the control in germination was 7%, seedling length 56 % , dry matter production 21% , seedling vigour index I 69% and for seedling vigour index II was 31% (Fig.1 to Fig.3.).

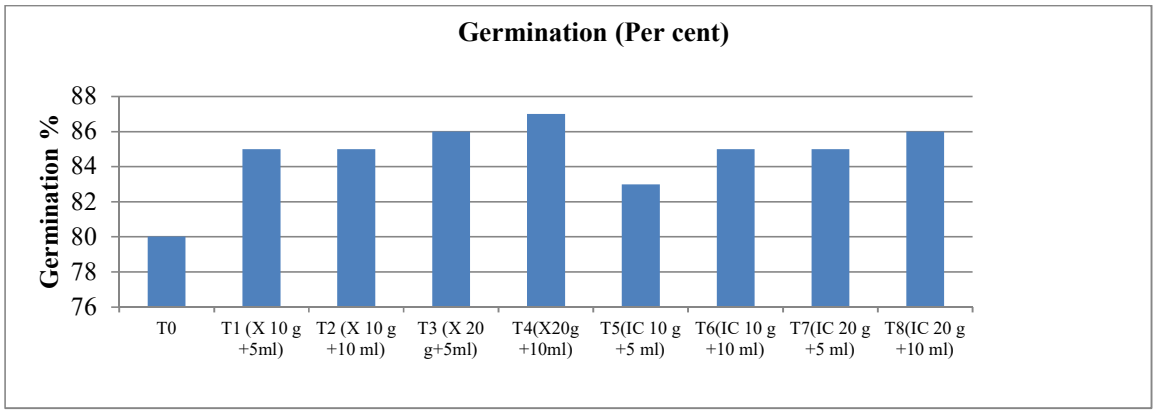

Fig. 1. Effect of Xanthan Gum seed coating on germination % of finger millet

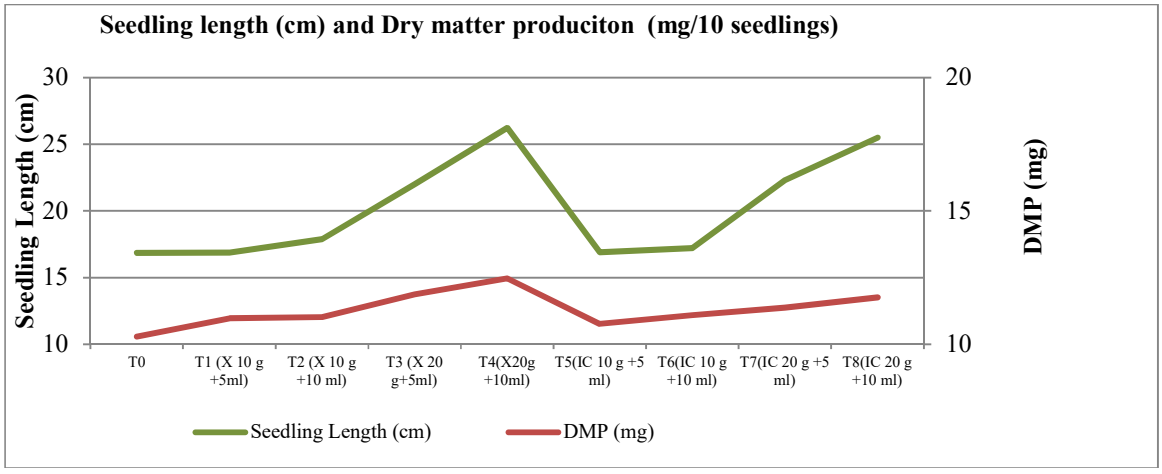

Fig. 2. Effect of HP seed coating on seedling length (cm) and dry matter produciton (mg/10 seedlings) in finger millet

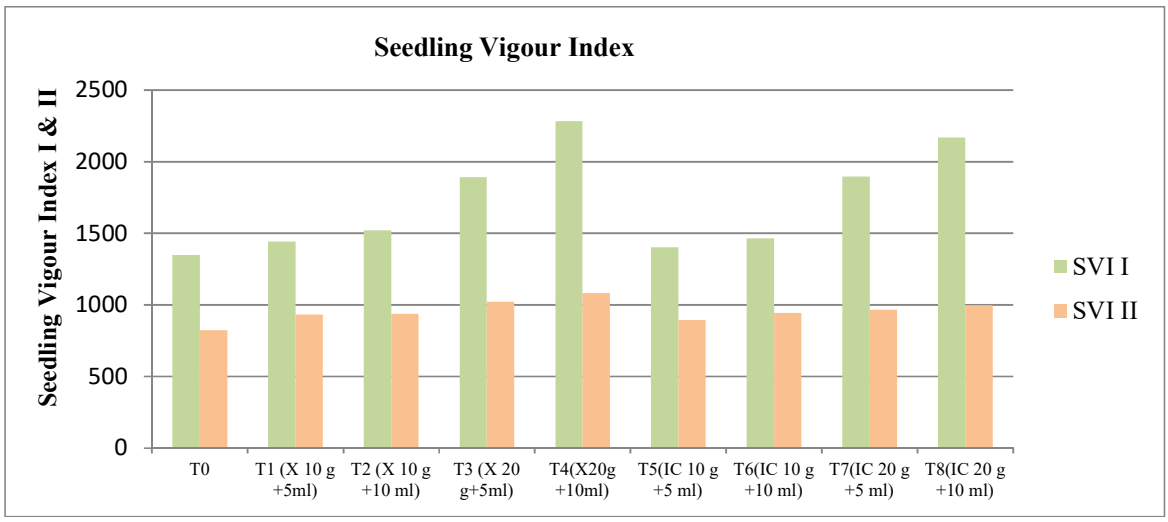

Fig.3. Effect of HP seed coating on seedling vigour index I and II in finger millet

The results were in agreement with Rambod *et al.,* (2018), Chang *et al.,* (2018) Salachna *et al.,* (2021) they reported that there was a positive correlation observed between seed coating with hydrophilic compounds and seed germination in various crops. The seeds coated with hydrophilic polymers could accelerates the seed imbibitions rate, reducing the time required for full germination, since, the colloidal nature of the hydrophilic polymers seed coating provides a large surface area for water absorption. *Maya Hotta et al.,*(2016) they reported that Super Absorbent Polymer coatings on seeds provide more efficient imbibitions of water,speed up germination and improved seedling growth. *Xanthan gum* an excellent organic hydrophilic polymer it could hold (3727times water) and it is suitable for the preparation of SAP (Super Absorbent Polymer). Coating Finger millet seeds with *Xanthan gum* an organic hydrophilic polymer is a promising technique for maintaining a high water potential in rainfed ecosystems.

Conclusion

Xanthan gum an excellent organic hydrophilic polymer can hold (3727times water) and it is suitable for the preparation of SAP (Super Absorbent Polymer) and can be recommended as a pre sowing seed coating technique for mitigating water stress. From the studies it could be concluded that Finger millet seeds coated with Xanthan gum @ 20 g per kg is a promising technique for maintaining a high water potential in rainfed ecosystems.

Conflict of interest

The authors declare that they have no conflicts of interest.

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