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Germination and vigour of polymer coated cotton seeds under different water holding capacities

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Abstract
The cotton seeds were coated with different polymers namely Genius coat 171, Genius coat 172, Arcus, Myconate and Quick roots and evaluated for various physiological quality parameters at water holding capacities of 30, 40, 50, 60, 70 and 80 per cent in sand medium along with untreated control seed. The seeds coated with Quick roots polymer recorded higher speed of germination (8.5), germination (88 %), root length (10.35 cm), shoot length (10.80 cm), dry matter production (489.9 mg seedlings^{-10}) and vigour index (1861), respectively over untreated control (5.5, 68, 9.00, 9.50, 458.6 and 1258, respectively) under suboptimal moisture condition like 30 per cent water holding capacity. Cotton seeds coated with Quick roots can tolerate both high as well as low moisture content and produce better germination and seedling establishment.

Keywords: Cotton seed, Polymers, Seed coating, Water holding capacities

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INTRODUCTION

Cotton is the world's leading natural fibre crop. It is called as "King of Fibres" and "White of Gold". India is the second largest cotton producer in the world. Gujarat is the major cotton producing states in India. Cotton crop not only provides fibre for the textile industry, but also plays a role in the feed and oil industries with its seed, rich in oil (18 – 24%) and protein (20 – 40%). Low crop productivity faced by Indian Agriculture is mainly because of poor soil health and various stress conditions. Though the high quality seeds are used for sowing in the field, it undergoes several stresses during the emergence and establishment leading to poor survival and reduced plant stand. Moisture content during germination leads reduced germination and poor seedlings growth (Chandra Kanta and Rao, 2014). One possible way to increase the plant water acquisition or drought tolerance is to use polymers as coating. The application of polymers to seed serves as an extra exterior shell in order to give the desired seed characteristics *viz.*, quick water uptake and enhanced germination that would be beneficial for better emergence and establishment in the given condition (Taylor *et al.,* 1998).

Polymer seed coating also increased the consumptive water use efficiency. It is due to increase in the rate of imbibition where the fine particles in the coating act as a 'wick' or moisture attracting material or perhaps to improve seed soil contact. The polymer coated corn seeds gave high seed germination than the uncoated seeds under water stress conditions (Schneider and Gupta, 1985). Therefore, the present study was undertaken to evaluate the germination and vigour of polymer coated cotton seeds under different water holding capacities.

MATERIALS AND METHODS

Genetically pure seeds of cotton (Akshay 65 F1Bt) were sent to the Integrated Coating Technology Pvt. Ltd., (INCOTEC), Ahmedabad, Gujarat for coating through machine with different polymers *viz.*, Genius coat 171, Genius coat 172, Arcus,

Myconate and Quick roots. The polymer coated cotton seeds along with untreated control were tested for physiological quality under various water holding capacities *viz.,* 30, 40, 50, 60, 70 and 80 per cent. The different water holding capacities (WHC) were created by adding enough quantity of water to a known quantity of sand to achieve the saturation point (100 per cent water holding capacity) from that the other water holding capacities were arrived and seeds sown at different water holding capacities. Seedling quality characteristics such as germination (ISTA, 1999), speed of germination (Maguire, 1962), root length (cm), shoot length (cm), dry matter production of 10 seedlings (mg) and vigour index (Abdul-Baki and Anderson, 1973) were calculated. The data were analysed statistically adopting the procedure described by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Cotton seed is susceptible to drought and seed germination is highly influenced by moisture status of the substrate. In order to get better establishment under very low and very high moisture status, polymer coating technology will be highly useful. The seeds coated with Quick roots polymer enhanced the speed of germination in all the water holding capacities and percent increase over control was 36, 32, 27, 28, 26 and 26 under 30, 40, 50, 60, 70 and 80 per cent water holding capacities, respectively (Fig. 1). The high speed of germination recorded at low moisture (30% WHC) stress condition could be attributed to the faster germination of polymer coated seed. Irrespective of the water holding capacities, the polycoated seeds recorded higher speed of germination than the uncoated seeds which might be due to the hydrophilic property of the polycoat, absorbed available moisture and increased the water uptake that resulted in quicker radicle emergence. Henderson and Hensley (1987) reported that seed coating with polymer could provide protection against water stress and the hydrophilic polymers are mostly used to enhance the rate of water uptake and coating the seeds with hydrophilic polymer is a promising technique for maintaining a high water potential around the germinating seeds and thereby ensuring the soil water content not to fall below the critical level before germination.

The germination potential is considered to be an important parameter for assessing the potentiality of seeds. The seeds coated with Quick roots recorded higher germination at various water holding capacities. The increase over untreated control seed was 20, 20, 16, 10, 10 and 8 per cent under 30, 40, 50, 60, 70 and 80% water holding capacities, respectively (Fig. 2). The relative increase in germination due to Quick roots polymer coating might be attributed to the hydrophilic property of the polycoated seed which preserves the moisture and prolongs the moisture supply under stress condition. These polymers are having the capacity to absorb water about 100 to 1000 times of their weight from the surrounding rhizosphere which act as a local reservoir over a period of time and water from this reservoir is released gradually to the

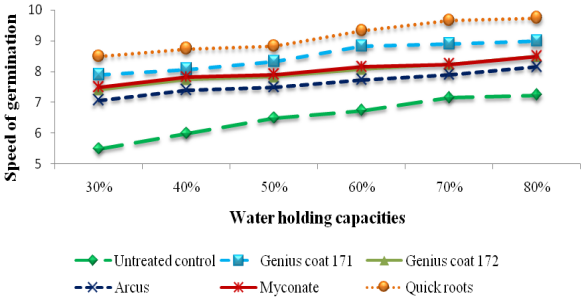

Fig.1. *Effect of polymer coating on speed of germination of cotton seeds at different water holding capacities under laboratory condition*

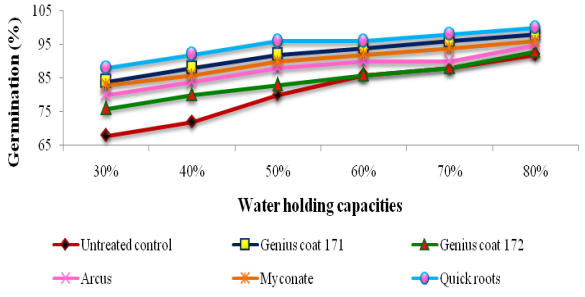

Fig.2. *Effect of polymer coating on germination of cotton seeds at different water holding capacities under laboratory condition.*

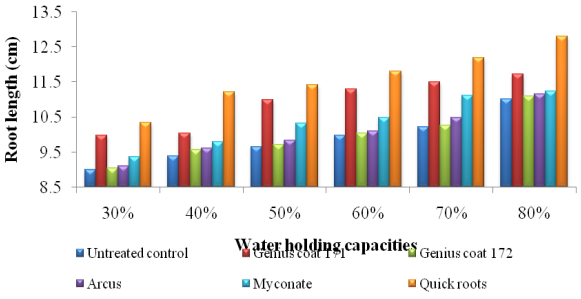

Fig.3.*Performance of polymer coating on root length (cm) of cotton seeds at different water holding capacities under laboratory condition.*

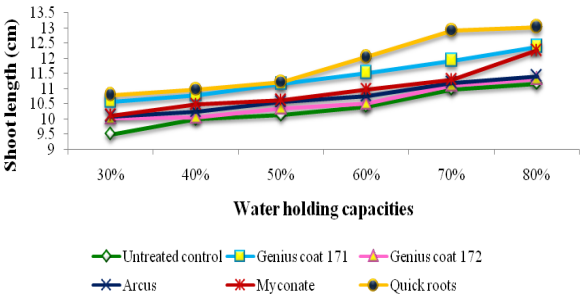

Fig. 4. *Effect of polymer coating on shoot length (cm) of cotton seeds at different water holding capacities under laboratory condition*

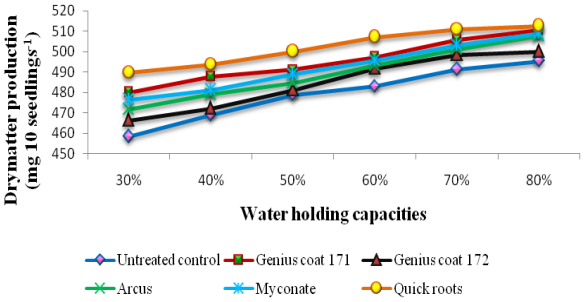

Fig 5. *Performance of polymer coating on drymatter production (mg seedlings^{-10}) of cotton seeds at different water holding capacities under laboratory condition*

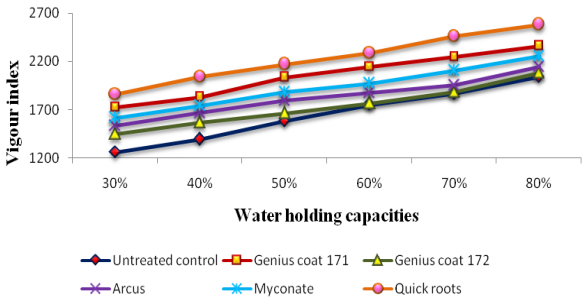

Fig. 6. *Performance of polymer coating on vigour index of cotton seeds at different water holding capacities under laboratory condition.*

soil and thereby to plants based on need (Iqbal and Srinivasan, 1987). Gaganpreet and Udai (2011) reported that polycoated seed was found to increase the seed germination under normal and water stress conditions in winter canola. Taylor and Kwiatkowski (2001) explained that film coating of snap beans with SB 2000 polymer at 0.5% greatly enhanced the germination in stress test. The results of the present study are in agreement with the findings of Baxter and Waters (1986) in sweet corn and cowpea and Renugadevi *et al.* (2009) in cluster bean.

The seeds coated with Quick roots polymer enhanced the root length (cm) in all the water holding capacities and percent increase over untreated control was 13, 16, 15, 15, 16 and 14 under 30, 40, 50, 60, 70 and 80 per cent water holding capacities, respectively (Fig. 3). Similar the trend in shoot length (cm) also. The seeds coated with Quick roots polymer shown highest shoot length in all the water holding capacities and percent increase over untreated control was 12, 9, 10, 14, 15 and 14 under 30, 40, 50, 60, 70 and 80 per cent water holding capacities, respectively (Fig. 4). The seeds coated with Quick roots polymer enhanced the dry matter production of 10 seedlings in all the water holding capacities and percent increase over untreated control was 6, 5, 4, 5, 4 and 3 under 30, 40, 50, 60, 70 and 80 per cent water holding capacities, respectively(Fig. 5). Rajasekaran (2004) reported that brinjal hybrid seed (COBH1) coated with polycoat (3g) and halogen mixture (3g) outperformed well in all the water holding capacities from 30 to 80%. This indicated that polycoated seeds recorded higher germination and seedling length at two extreme moisture levels namely low and high moisture regimes.

In the present study, the percent of vigour index increase over untreated control seed was 33, 32, 28, 24, 25 and 22 under 30, 40, 50, 60, 70 and 80% water holding capacities, respectively (Fig. 6). The increase in vigour index under moisture stress conditions might be attributed that the polymer coating could provide protection against water stress and help the seedling to grow faster and vigourous. The polymer coating had high water conductivity and improved the seed water contact area which is important in water uptake of the seed and it expands on hydration and increases the area of liquid seed contact, a factor critical to imbibition (Handas and Ruso, 1974). Renugadevi *et al.* (2009) revealed that the maximum vigour index was observed due to polycoat along with bavistin had recorded 44 per cent improvement than the uncoated cluster bean seeds under moisture stress conditions.

Conclusion

The cotton seeds coated with quick roots polymer produced faster, uniform germination and high vigourus seedlings both under low and high moisture levels.

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