Oryza Vol. 50. No. 4, 2013 (324-328)

Germination and vigour of polymer coated CORH 3 hybrid rice seeds under different water holding capacities

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ABSTRACT

CORH 3 hybrid rice 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% in sand medium along with untreated control. The seeds coated with Quick roots polymer performed well even under suboptimal moisture condition like 30% water holding capacity, recorded 18, 15, 11, 13 and 13 per cent higher speed of germination, rate of germination, root length, shoot length, dry matter production and vigour index, respectively over untreated control. The result indicated that the rice seeds coated with Quick roots can tolerate both high as well as low moisture content and produce better germination and seedling establishment

Key words: *polymers, seed coating, rice, water holding capacities*

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. 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.

Polymer coating acts as a temperature switch and protective coating for seeds by regulating the intake of water, until the soil has warmed to a pre-determined temperature. Many organic and inorganic polymers are known to improve the plantability by regulating needed moisture to spark germination. 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 CORH 3 hybrid rice seeds under different water holding capacities.

MATERIALS AND METHODS

Genetically pure seeds of CORH 3 hybrid rice were obtained from the Paddy Breeding Station, Tamil Nadu Agricultural University, Coimbatore and 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 CORH 3 hybrid rice 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 experiment was set up by adopting completely randomised design with four replications of 100 seeds were sown in all the above water holding capacities (WHC) for each treatment. The different water holding capacities 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. After the germination period of 14 days, the germination test was evaluated for their seed and seedling quality characteristics such as germination (ISTA, 1999), speed of germination (Maguire, 1962), root length (the distance between the collar region to the tip of the primary leaf), dry matter production of 10 seedlings (seedlings dried in a hot air oven maintained at 103±2°C for 16 ± 1h and cooled for 30 min and weighed in an electronic digital balance) and vigour index(Abdul-Baki and Anderson, 1973). The data were analysed statistically adopting the procedure described by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

The seeds coated with Quick roots polymer enhanced the speed of germination in all the water holding capacities and percent increase over control was 18, 18, 17, 19, 19 and 18 under 30, 40, 50, 60, 70 and 80% 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)

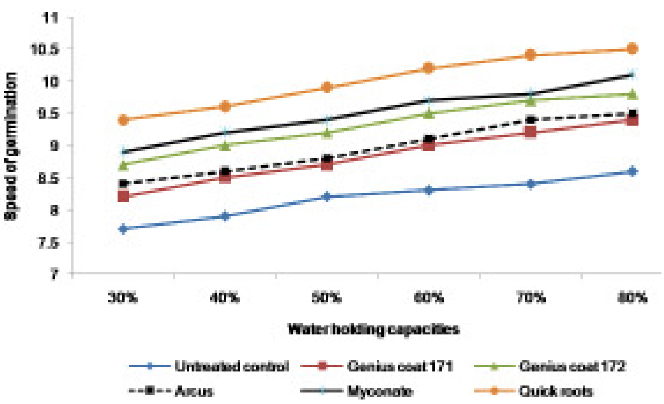

Fig.1. Effect of polymer coating on speed of germination of CORH3 hybrid rice seeds at different water holding capacities

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 (Plate 1). The increase over untreated control seed was

30%

50%

80%

S1 - Untreated control S6 – Quick roots

Plate 1. Germination and seedling vigour of CORH 3 hybrid rice seeds coated with Quick roots under 30, 50 and 80% water holding capacities

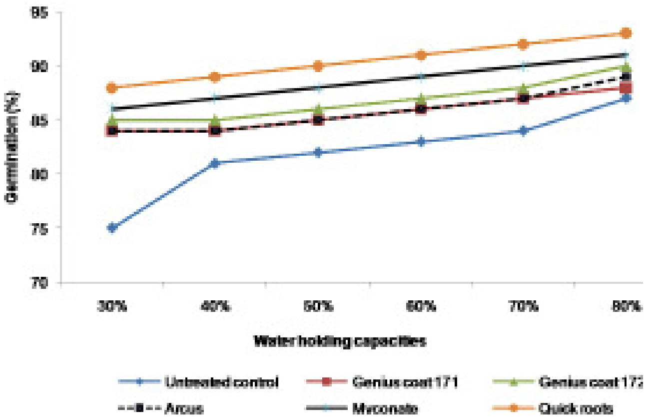

Fig. 2. Effect of polymer coating on germination of CORH 3 hybrid rice seeds at different water holding capacities

15, 9, 9, 9, 9 and 6 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 coating of snapbeans 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.

Seed quality attributing characters are the best indicator of seed vigour. The seeds coated with Quick roots polymer enhanced the root length in all the water holding capacities and per cent increase over untreated control was 11, 14, 13, 15, 14 and 16 under 30, 40, 50, 60, 70 and 80% water holding capacities, respectively (Table 1). Similar the trend in shoot length (cm) (Plate 1) also. The seeds coated with Quick roots polymer had highest shoot length in all the water holding capacities and per cent increase over untreated control was 13, 15, 17, 18, 19 and 21 under 30, 40, 50, 60, 70 and 80% water holding capacities, respectively.

Table 1. Performance of polymer coating on root length (cm) of CORH 3 hybrid rice seeds at different water holding capacities

Polymer coating treatments (S)	Water holding capacities (M)						
	30%	40%	50%	60%	70%	80%	Mean
Untreated control	7.4	7.6	7.9	8.1	8.4	8.7	8.0
Genius coat 171	7.6	7.8	8.1	8.3	8.6	8.9	8.2
Genius coat 172	7.8	8.0	8.4	8.6	8.8	9.2	8.4
Arcus	7.7	7.9	8.3	8.5	8.7	8.9	8.3
Myconate	8.0	8.3	8.6	8.9	9.2	9.6	8.7
Quick roots	8.3	8.8	9.1	9.5	9.8	10.4	9.3
Mean	7.8	8.0	8.4	8.6	8.9	9.2	
CD ($P<0.05$) M	0.04**						
S	0.04**						
M x S	0.11**						

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 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

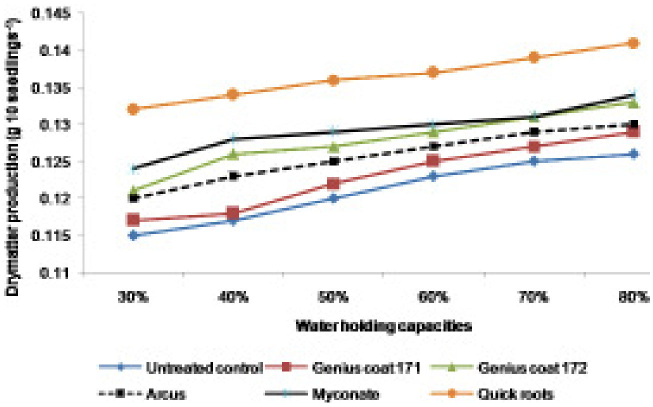

Fig. 3. Effect of polymer coating on dry matter production (g 10 seedlings^{-1}) of CORH 3 hybrid rice seeds at different water holding capacities

The seeds coated with Quick roots polymer enhanced the dry matter production of 10 seedlings in all the water holding capacities and per cent increase over untreated control was 13, 13, 12, 10, 10 and 11 under 30, 40, 50, 60, 70 and 80% water holding capacities, respectively (Fig. 3).

Rajasekaran (2004) reported that brinjal hybrid seed (COBH1) coated with polycoat and halogen mixture outperformed well in all the water holding capacities from 30 to 80%. This indicated that polycoated seeds recorded higher germination and 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.

The rice seeds coated with quick roots can produce faster and uniform germination and high vigourous seedlings both under low and high moisture levels.

Table 2. Performance of polymer coating on vigour index of CORH 3 hybrid rice seeds at different water holding capacities

Polymer coating treatments (S)	Water holding capacities (M)						
	30%	40%	50%	60%	70%	80%	Mean
Untreated control	1178	1298	1347	1396	1475	1549	1373
Genius coat 171	1352	1386	1445	1514	1583	1654	1489
Genius coat 172	1428	1471	1540	1583	1654	1755	1571
Arcus	1378	1411	1488	1548	1601	1691	1519
Myconate	1479	1549	1611	1673	1755	1842	1651
Quick roots	1566	1673	1744	1838	1914	2046	1798
Mean	1396	1464	1530	1592	1663	1756	
CD (P<0.05) M	14**						
S	14**						
M x S	34**						

seedling length at two extreme moisture levels namely low and high moisture regimes. These results are consistent with that of Willenborg *et al.* (2004) in canola.

Vigour of seedlings is usually characterized by weight of the seedlings after a period of growth. The computed vigour index, which is the totality of performance, has been regarded as a good index to measure the quality of seed. In the present study, the percent of vigour index increase over untreated control seed was 25, 22, 23, 24, 23 and 24 under 30, 40, 50, 60, 70 and 80% water holding capacities, respectively (Table. 2). The increase in vigour index under moisture stress conditions possibly be due to protection against water stress and help the seedling to grow faster and vigourously provided by the polymers. The polymer coating had high water conductivity and improved the seed water contact area which is important in water

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