Germination of different soybean cultivars at different soil water potential as a function of time

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ABSTRACT

A lab experiment was conducted during 2014-15 in the department of Soil Science and Agricultural Chemistry, College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra using six different soybean cultivars (JS-335, MAUS-71, MAUS-158, MAUS-162, MAUS-504 and MAUS-609) to study the germination of soybean varieties under two moisture levels of 50 and 100 per cent field capacity different soil water potential as a function of time. The experiment was laid out on clayey soil with six treatment combinations (soybean cultivars). Amongst all soybean varieties, MAUS-71 and MAUS-158 showed complete germination within 60 hours under 50 per cent field capacity. MAUS-162 and MAUS-609 showed complete germination within 36 hours under 100 per cent field capacity where optimum soil moisture was available for germination. The germination was more centralized between 20 to 36 hours in varieties under 100 per cent field capacity moisture level.

Keywords: Seed; soybean; germination; moisture; time function

INTRODUCTION

Seed germination is an important stage in plant growth that can be used to predict plant productivity. Seed germination is characterized as a series of events that begin with seed hydration and end with the embryonic axis emerging out from the seed coat. Rapid and uniform emergence needs optimum water for germination. Germination of seeds usually involves three stages, the first of which is a seed hydration process involving imbibition of seed tissues and water movement in the seed (water absorption). The second stage is the activation stage which is related to the re-establishment of metabolic activities and cellular level repairing processes and the last and third stage is the initiation of growing processes such as radical protrusion and cell elongation (Lutts et al 2016).

As moisture is required for seed germination, the lack of moisture over a certain level results in germination failure, crop failure and retarded seed germination. Imbibition or water absorption is the first step in seed germination and after that radicle and cotyledon growth takes place. In the case of soybean seeds following imbibition, the moisture content rises to 50 per cent from less than 13 per cent. If the temperature is suitable after imbibition, the primary root develops downwards. In a wet seedbed, optimum seed-soil contact is needed for optimal seed germination. Because it transforms dried inactive seed into a developing embryo, imbibition is a critical stage in germination. Other elements that influence seed germination include soil conditions, aeration and temperature. In order to achieve a high yield with good quantity and quality in annual crops, uniform and early emergence is required (Yari et al 2010).

MATERIAL and METHODS

A laboratory experiment was conducted during 2014-15 in the Department of Soil Science and Agricultural Chemistry, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra using six different soybean cultivars to study the soil water potential and germination of soybean varieties under different soil types. The pot culture experiment was

laid out on clayey soil with six soybean cultivars (JS-335, MAUS-71, MAUS-158, MAUS-162, MAUS-504 and MAUS-609) used at two moisture levels viz 50 and 100 per cent field capacity. The present investigations were conducted using clayey soil having pH 7.7 and field capacity of 36.0 per cent. The details about soil properties of experimental soils and methods are given in Table 1. The soybean varieties were evaluated for their germination rate under different soil moisture levels. Twenty healthy seeds of each cultivar were placed in Petri dishes containing 200 g of soil at a depth of 10 mm at 28 ± 1°C (Mali et al 1978a). The germination was defined when 2 mm long radical sprouted from the seed coat. The time of germination was considered by recording germination percentage up to 96 h.

RESULTS and DISCUSSION

The data presented in Table 2 indicate that amongst all soybean varieties MAUS-71 and MAUS-158 showed complete germination within 60 hours under 50 per cent field capacity. This may be due to low moisture percentage of clay soil that delayed the germination of all cultivars. The variation in the germination rate might be due to variation in seed surface area and genetic makeup and due to the reason that low soil water potential decreases the availability of water to the seeds and the time required for imbibition of water to move to the seed increases. Hadas (1969) reported that if the rate of water to the seed is decreased, it takes more time as the soil dries. Consequently the rate of germination decreases.

MAUS-162 and MAUS-609 showed complete germination within 36 hours under 100 per cent field capacity where optimum soil moisture was available for germination (Table 3). The germination was more centralized between 20 to 36 hours in varieties under 100 per cent field capacity moisture level. This shows that optimum availability of moisture is also one of the important factors that decide the early germination of seeds hence there was continuous film of water around the seeds (Mali et al 1978b).

Table 1. Mechanical and chemical composition of experimental soil

Component	Clay soil	Method
Coarse sand (%)	11.5	International pipette method (Piper 1966)
Fine sand (%)	9.9	
Silt (%)	14.5	
Clay (%)	60.2	
pH	7.7	Suspension ratio of 1:2.5 of soil water (Jackson 1973)
EC (dS/m)	0.06	1:2.5 soil water ratio (Jackson 1973)
Organic carbon (g/kg)	3.75	Walkley and Black's rapid titration method (Piper 1966)
Calcium carbonate (g/kg)	80.0	Rapid titration method (Piper 1966).
CEC (Cmol (p+)/kg)	52.14	Ammonium acetate method (Jackson 1973)
Field capacity (%)	36.0	Method #30, USDA Handbook #60 (Richards 1954)

Table 2. Germination rate of different soybean cultivars at 50 per cent field capacity as a function of time

Variety	Time required for germination (h)																	
	8	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80
JS-335	-	-	-	-	-	-	-	-	5	5	10	-	5	-	5	NFG		
MAUS-71	-	-	-	-	-	-	-	5	5	10	10	NFG						
MAUS-158	-	-	-	-	-	-	-	-	-	-	5	20	NFG					
MAUS-162	-	-	-	-	-	-	-	-	-	10	20	10	5	-	5	-	5	NFG
MAUS-504	-	-	-	-	-	-	-	-	-	-	10	15	15	5	10	5	NFG	
MAUS-609	-	-	-	-	-	-	-	-	-	20	10	15	-	-	-	-	-	5

NFG= No further germination

Table 3. Germination rate of different soybean cultivars at 100 per cent field capacity as a function of time

Variety	Time required for germination (h)								
	8	16	20	24	28	32	36	40	44
JS-335	-	-	10	40	5	20	15	NFG	
MAUS-71	-	-	30	15	35	5	10	-	NFG
MAUS-158 -	-	10	55	20	10	-	5	NFG	
MAUS-162 -	-	-	75	15	10	NFG			
MAUS-504 -	-	-	40		45	10	5	NFG	
MAUS-609 -	10	60	20	5	5	NFG			

NFG= No further germination

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