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# Germination percentage and seed hydration value of soybean cultivars under water saturated blotter paper at different time intervals

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**Abstract**
A lab experiment was conducted during 2014-15 at department of Soil science and Agril. Chemistry, College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani using different six soybean cultivars to study the seed hydration value for germination of soybean varieties. The treatment consist of six soybean cultivars *viz*. JS-335, MAUS-71, MAUS-158, MAUS-162, MAUS-504 and MAUS-609. The results emerged out clearly indicated that various parameters like seed germination percentage, Seed hydration value and seed germination rate was different for different cultivars under study. Amongst all cultivars MAUS-504 is best for rainfed / dry land areas because the variety MAUS-504 had lowest seed hydration value. JS-335 and MAUS-71 showed maximum seed hydration value and reduction in germination to a great extend under critical moisture level. These varieties showed optimum germination under sufficient moisture level condition.

**Keywords:** Seed, germination, hydration and moisture

## Introduction
It is well known fact that moisture imbibitions by seed is a pre-requiste for germination. For almost all crops, moisture is needed at the time of germination, early seedling and later growth stages. Seeds, however require an optimal range of moisture beyond which either they fail to germinate or the germination is poor. The rate of seed germination is affected by the percentage of soil moisture present in the germination medium. The occurrence and the rate of germination are considerably influenced by soil moisture matric potential and hydraulic conductivity. The seeds of peas, soybean, corn and wheat failed to germinate at or below the wilting coefficient. Collis-George and Hector (1966) [2], Sedgley (1963) [7] and Manohar and Hydecker (1964) [6]. Mali *et al.,* (1978) [4, 5] had made an attempt to evaluate the critical soil moisture and seed hydration for the germination of various cultivars of sorghum.
After soybean seed is planted in the soil, it will start to absorb or imbibe water and swell, and as a result changing the matter content from less than 13% to almost 50% in several hours. With favourable temperatures and within one or two days, the first root (radical) of the swollen seeds emerges through the seed coat and grow downward to develop primary seedling root. Planting in to a moist seed bed with good seed to soil contact is necessary as moisture needs to move in to the seed for germination to occur. Soil crusting can delay or prevent seedling emergence and cause soybean hypocotyls to become swollen or broken when trying to push through the crust, fields with fine textured soil, low organic matter and little surface residue can be vulnerable to crusting, especially where excessive tillage has taken place.
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. Seed germination is an important stage in plant growth that can be used to predict plant productivity. Rapid and uniform emergence is needed for successful early seedling establishment. Germination of seeds usually involves three distinct stages, the first of which is a seed hydration process involving imbibitions of seed tissues and water movement in the seed. The second stage is the activation stage, which is associated with the re-establishment of metabolic activities and cellular level repairing processes and the third and last stage is the initiation of growing processes such as cell elongation and radical protrusion (Lutts *et al.,* 2016) [3].

## Materials and Methods

In all six soybean cultivars / varieties *viz*. JS-335, MAUS-71, MAUS-158, MAUS-162, MAUS-504 and MAUS-609 were selected and from each cultivar 20 seeds were taken for moisture absorption as well as germination count studies. The germination and seed hydration value of these cultivars were tested in blotter paper.

This experiment was carried out in the laboratory of Soil Science and Agricultural Chemistry Department in Parbhani during 2014-2015 using 6 Varieties of Soybean in Petri dishes for calculation of germination related parameters and seed hydration value of seeds.

Before placed seeds, petri dishes were washed thoroughly with tap water and then with distilled water. For this experiment, good quality soybean seeds of six different varieties having good physical purity such as uniform shape, size, color and high genetic purity with good germinability were used. 20 viable seeds of each variety were selected and placed in all petri plates at equal distance and covered petri dishes.

The seeds were allowed to remain till the germination, from the germination seeds, uptake of water was determined on percentage basis. The seeds were weighed at 4 hrs. Interval up to 56 hrs. and first and second observation was taken at eight hrs. interval. The weight of germinated seed was taken at each interval. Weight was taken in milligram basis and percentage were calculated. The amount water absorbed by seed / seed hydration was determined.

Seed hydration was calculated by using formulae (Seed weight at observation – Initial seed weight). The seed weight was taken at each interval starting from 8 hrs. to 56 hrs. of water imbibition. Volume of seeds were determined by displacement of water by 100 seeds and volume of each seed was computed.

## Results and Discussion

The data presented in Table. 1 indicates the seed characteristics of soybean varieties / cultivars used in the present investigation. It was observed that MAUS-609 and JS-335 cultivars showed high seed index. The MAUS-504 had low seed index. Seed moisture (air dry) was ranged between 12 to 15 percent and seed volume from 0.5 $cm^3$ (MAUS-504) to 0.65 $cm^3$ (MAUS-609).

From each cultivar 20 seeds were selected for moisture absorption as well as germination count. Seeds which were taken for experiment were chosen randomly. No chemical seed treatment was applied.

The germination of different soybean cultivars was found to be in the range of 85 to 100% in saturated blotter paper (without soil). The average germination occurred for different cultivars in descending order as MAUS 162≥609≥504≥71≥JS-335 and MAUS-158 (Table-2, Fig. 1). The results indicated that the germination rate of various cultivars has differed even though moisture was not limiting. The variation in the germination might have been due to variation in seed surface area and genetic makeup. The variation in germination percentage was also observed by Mali (1978) [4, 5] in sorghum. They attributed the germination variation to the genetic makeup and surface area. Amongst all cultivars MAUS-158 showed complete germination within 44 hrs. which was found to be earliest amongst all.

The data presented in Table-3 and depicted figure 2 indicated significant differences in seed hydration due to varietal differences. The seeds of JS-335, MAUS-71 and MAUS-609 having higher seed hydration value *i.e.* ≥0.30 g. Where as MAUS-504 recorded lowest seed hydration value *i.e.* 0.125 g. for germination. The MAUS-504 which is having small seed size and seed coat influenced the imbibitions rate and showed lowest (0.125 g.) seed hydration value. The seed coat microstructure and composition affects the imbibitions rate (Borji *et al.* 2007). It also related to seed coat thickness and size of micropyle. The low imbibition rate ultimately leads to low hydration and enhance the critical limit of hydration in a given seed and therefore there will be low germination. This ultimately results in low plant population per hectare even when the recommended seed rate is followed. These result suggest that while breeding yield potential varieties attention should be paid not to have high seed hydration value.

**Table 1:** Seed characteristics of selected soybean cultivars

| Sr. No. | Verities / cultivar | Moisture (%) (Air dry) | Seed Index (gm) | Seed volume ($cm^3$) |
|---|---|---|---|---|
| 1 | JS-335 | 13 | 14.364 | 0.6 |
| 2 | MAUS-71 | 15 | 13.341 | 0.6 |
| 3 | MAUS-158 | 12 | 11.715 | 0.5 |
| 4 | MAUS-162 | 13 | 13.989 | 0.6 |
| 5 | MAUS-504 | 12 | 11.152 | 0.5 |
| 6 | MAUS-609 | 13 | 14.572 | 0.65 |

**Table 2:** Germination percentage of soybean cultivars under water saturated blotter paper at different time intervals

| Sr. No. | Varieties | Time required for germination (Hours) | | | | | | | | | | | | Not germinated seeds | Percent Germination |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0-8 | 0-16 | 0-20 | 0-24 | 0-28 | 0-32 | 0-36 | 0-40 | 0-44 | 0-48 | 0-52 | 0-56 | | |
| 1 | JS-335 | - | - | - | 3 | - | 4 (7) | 2 (9) | 3 (12) | 1 (13) | 2 (15) | 2 (17) | - | 3 | 85 |
| 2 | MAUS-71 | - | 1 | 1 (2) | 4 (6) | 1 (7) | 5 (12) | 2 (14) | 2 (16) | - | 1 (17) | 1 (18) | - | 2 | 90 |
| 3 | MAUS-158 | - | - | 1 | 2 (3) | 2 (5) | 4 (9) | 3 (12) | 4 (16) | 1 (17) | - | - | - | 3 | 85 |
| 4 | MAUS-162 | - | - | - | 1 | 1 (2) | 3 (5) | 1 (6) | 6 (12) | 4 (16) | 4 (20) | - | - | - | 100 |
| 5 | MAUS-504 | - | - | - | - | 1 | 3 (4) | 5 (9) | 5 (14) | 3 (17) | 1 (18) | 2 (20) | - | - | 100 |
| 6 | MAUS-609 | - | 2 | 2 (4) | 4 (8) | 4 (12) | 3 (15) | 2 (17) | - | - | 3 (20) | - | - | - | 100 |

| | | |
|---|---|---|
| | SE± | 4.70 |
| | CD at 5% | 12.30 |

(Figures in parenthesis indicate progressive total of number of seeds germinated)

**Table 3:** Effect of water saturated blotter paper on wet seed weight and seed hydration of soybean at various time intervals

| Sr. No. | Varieties | Time (Hours) | | | | | | | | | | | | Wet seed weight (g seed$^{-1}$) | Dry seed weight (g seed$^{-1}$) | Seed hydration (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0-8 | 0-16 | 0-20 | 0-24 | 0-28 | 0-32 | 0-36 | 0-40 | 0-44 | 0-48 | 0-52 | 0-56 | | | |
| 1 | JS-335 | - | - | - | 0.7 (3) | - | 1.2 (4) | 0.6 (2) | 0.9 (3) | 0.4 (1) | 0.7 (2) | 0.6 (2) | - | 0.30 | 0.145 | 0.155 |
| 2 | MAUS-71 | - | 0.3 (1) | 0.3 (1) | 1.2 (4) | 0.3 (1) | 1.5 (5) | 0.6 (2) | 0.6 (2) | - | 0.3 (1) | 0.3 (1) | - | 0.30 | 0.140 | 0.160 |
| 3 | MAUS-158 | - | - | 0.3 (1) | 0.5 (2) | 0.5 (2) | 1.2 (4) | 0.9 (3) | 1.1 (4) | 0.4 (1) | - | - | - | 0.28 | 0.130 | 0.150 |
| 4 | MAUS-162 | - | - | - | 0.2 (1) | 0.3 (1) | 0.9 (3) | 0.2 (1) | 1.7 (6) | 1.2 (4) | 1.3 (4) | - | - | 0.29 | 0.145 | 0.145 |
| 5 | MAUS-504 | - | - | - | - | 0.2 (1) | 0.7 (3) | 1.2 (5) | 1.3 (5) | 0.7 (3) | 0.2 (1) | 0.5 (2) | - | 0.24 | 0.115 | 0.125 |
| 6 | MAUS-609 | - | 0.5 (2) | 0.5 (2) | 1.2 (4) | 1.5 (4) | 0.9 (3) | 0.5 (2) | - | - | 1.0 (3) | - | - | 0.30 | 0.150 | 0.150 |
| | | | | | | | | | | | | | | | SE ± | 0.01 |
| | | | | | | | | | | | | | | | CD at 5% | 0.03 |

(Figures in parenthesis indicate progressive total of number of seeds germinated)

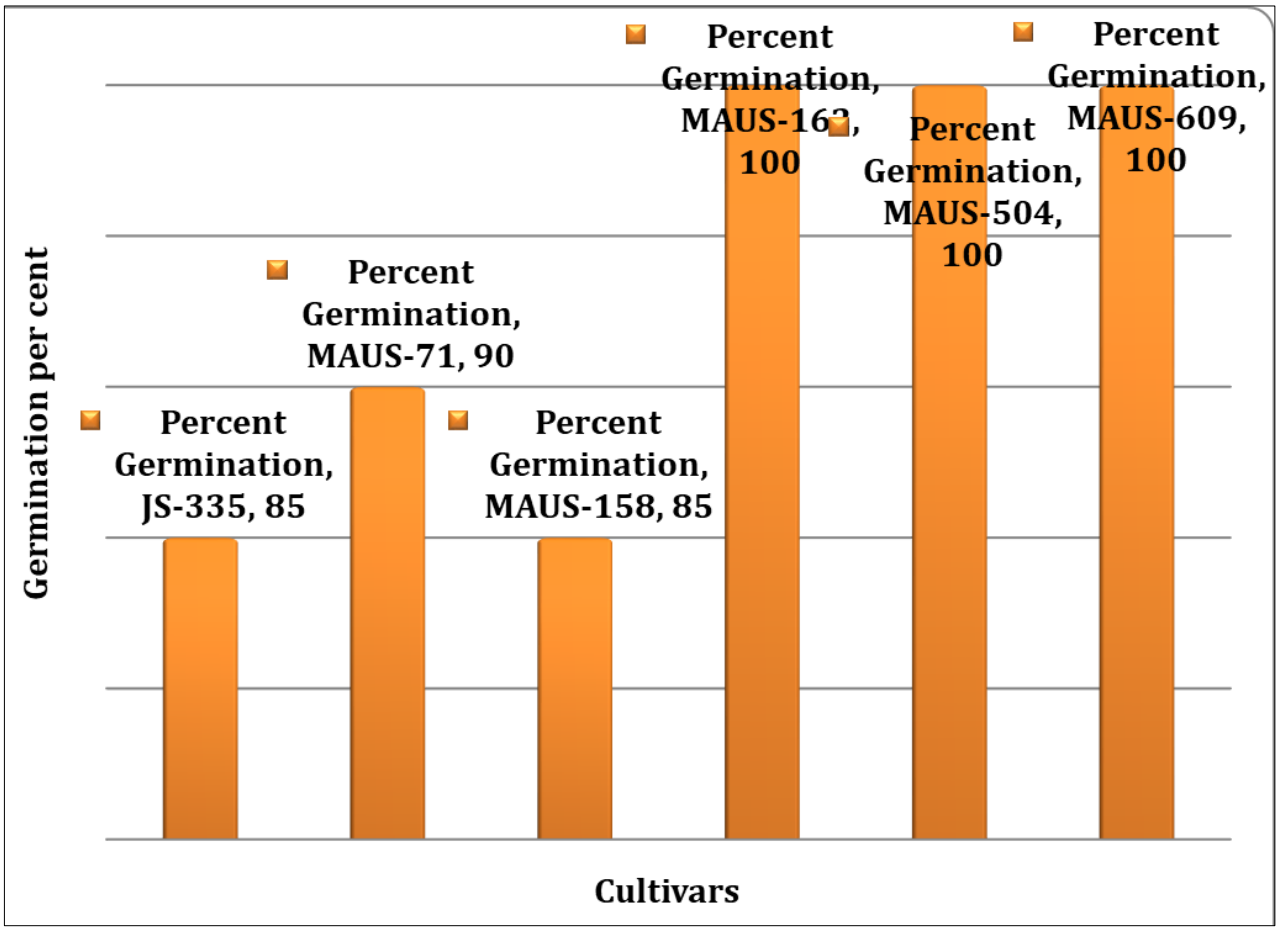


**Fig 1:** Germination percentage of soybean cultivars under water saturated blotter paper at different time intervals

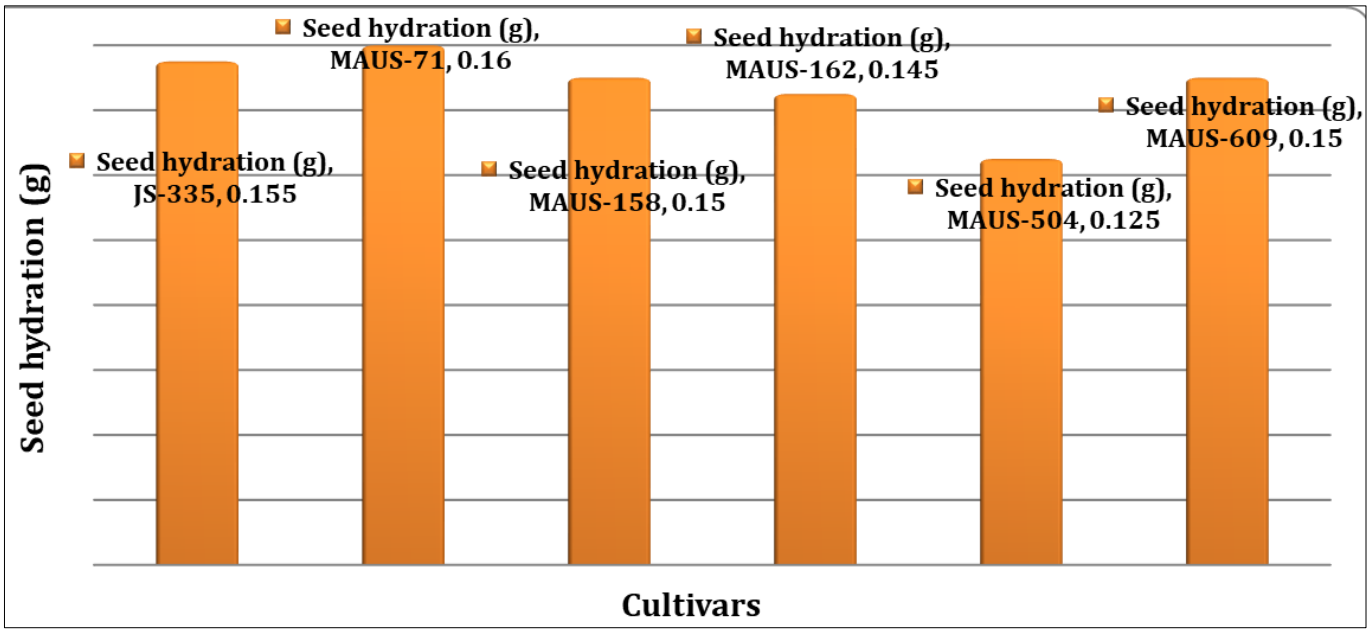


**Fig 2:** Effect of water saturated blotter paper on wet seed weight and seed hydration of soybean at various time intervals

## Conclusion

Amongst all cultivars MAUS-504 is best for rainfed / dry land areas because the variety MAUS-504 had lowest seed hydration value and require minimum critical soil moisture level for germination. JS-335 and MAUS-71 showed maximum seed hydration value and reduction in germination to a great extend under critical moisture level. These varieties showed optimum germination under sufficient moisture level condition. In breeding programme / variety evaluation programme for rainfed the cultivars must be tested for their seed hydration value.

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