EMERGENCE FORCES OF SNAP BEAN SEEDLINGS

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Sowing seeds and their subsequent germination, and seedling establishment, are annual events in crop production. The soil acts as a physical barrier to seedling emergence and may decrease or even prevent seedling establishment especially under conditions of soil crusting or soil compaction. Seedlings must therefore exert adequate force to emerge through the soil.

The purpose of this study was to quantify seedling emergence forces from snap beans. Instrumentation was developed to measure the combined seedling emergence forces of 50 seedlings (3). Force is reported as newtons (N), and 1N = 102 grams. Results from two studies are presented; 1) the effect of seed size and 2) the influence of chilling injury on subsequent emergence forces.

Snap bean seeds 'Bush Blue Lake 47', from the same seedlot, were sized into 3 groups; 200, 275 and 350 mg seed^{-1}. Fifty seeds of each size were sown in plastic containers filled with pasteurized sand and watered to 15% moisture content. The sown seeds were maintained at 25^{0}C until the hypocotyls were visible at the sand surface. The emergence forces of the seedlings were then monitored over time. The total force, time to reach maximum force and percent seedling emergence were determined. There were four replications per treatment and the treatment sums of squares were partitioned into single degrees of freedom.

Table 1. Seedling emergence force characteristics from sized snap bean seeds.

Relative seed size	Seed weight (mg)	Total force (N)	Time to reach max. force (hours)	Seedling emergence (%)	Force per seedling (N)
Small	200	123	32	79	3.12
Medium	275	160	34	88	3.61
Large	350	192	43	89	4.30
linear		**[z]	NS	**	**

[z] ** significant at the 1% level.

Chilling injury is a physiological disorder which occurs when seeds are sown in cold wet soils. Imbibition is the period of germination in which the seeds are sensitive to chilling injury and seeds with low initial moisture content (less than 8%, fresh weight basis), are more susceptible than high moisture content seeds (1). The influence of chilling injury was

studied on seedling emergence forces. Snap bean seeds 'Bush Blue Lake 47' were equilibrated to 8 or 12% moisture content (fr. wt basis). Fifty seeds of the selected moisture content were sown in flats filled with sand and watered to 15% (dry wt basis). The flats were maintained at either 5°C or 25°C for the first 24 hours and then transferred to 25°C until the hypocotyl hooks were visible at the sand surface. Measurements were performed as described for the seed size study. There were four replications per treatment and the study was analyzed as a 2x2 factorial (2 initial moisture contents x 2 imbibition temperatures).

Total force, percentage seedling emergence, force per seedling and seedling pressure, increased in a linear trend as seed size increased (Table 1). A trend existed (though not significant) that small seeded snap beans reach maximum force faster than larger seeds. A significant positive correlation has been reported between emergence forces and seed size among cultivars of kidney bean and pea (2).

Table 2. Emergence forces of snap bean seedlings influenced by initial seed moisture content and imbibition temperature.

Percent seed moisture	Imbibition temperature (°C)	Total force (N)	Time to reach max. force (hours)	Seedling emergence (%)	Force per seedling (N)
8	25	126 b	48 b	82 b	3.0 b
12	25	168 a	39 b	93 a	3.6 ab
8	5	79 c	64 a	67 c	2.4 c
12	5	171 a	47 b	89 ab	3.8 a

LSD 5%

Seedling emergence forces were influenced by the interaction of imbibition temperature and initial seed moisture content (Table 2). No differences were observed in either total force or seedling emergence from 12 percent moisture seeds imbibed at either temperature. A decrease in maximum force exerted and a longer time to obtain the maximum force, was recorded from low moisture seeds imbibed at low temperature.

References

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