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ROLE OF SOIL TEXTURE AND DEPTHS ON THE EMERGENCE OF BURIED WEED SEEDS

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ABSTRACT

Glass house pot experiment was performed to test the effect of soil texture and depths on the emergence of seeds of various weeds grow in the fields of wheat. Seeds of different weed species were sown in three different depths (2cm, 4cm and 6cm) of both sandy loam and clay loam textured soil. Pots were fully labeled according to type of species, soil textured class, sowing depths and replicates wise. Pots were placed in the glasshouse in a completely randomized block design. From this study, *Avena fatua* L. and *Vicia sativa* L. showed significantly more germination i.e., 46±3.69 and 48±3.85, respectively than the remaining four other types of weed seeds. The lowest germination i.e., 20±1.59 was found in the case of *Galium aparine* L. There were also observed that seed germination (P<000*) significantly decreased with the increase of seed sowing depth. Increasing the depth more and more, decreasing the germination of seeds, because deep sowing seeds were under the less pressure of oxygen, which is very important for the vital activities of seeds. Sandy loam texture soil was best for maximum germination of seeds (P<000*). The aim of experiment was to investigate the suitability of various species seeds under the soil texture and seed sowing depth.

Keywords: weed seeds, soil texture, soil depths, germination.

INTRODUCTION

Agricultural land in the world as well as in Pakistan restrains diversity in the soil texture. Topographically different soil texture classes are formed due to composite components of soil micelles. These compositions of soil play an important role in the germination mechanism of seeds of various plant species. In Pakistan, especially in study area there are recognized two types of soil texture by the edaphologist i.e., clay loam and sandy loam. Soil texture and seed buried position significantly affected subsequent growth. In addition, species differed in their response to soil types for multiple growth traits. Good seed depth is 1.5 to 2.0 inches or even deeper is recommended in dry conditions to ensure good moisture availability for successful seed germination (Al-kaisi, 2000). Jun Ren *et al*., (2002) determined the effects of sand burial on seed germination and seedling emergence of ten *Calligonum* L. species and suggested that the deeper the seeds in sand, the lower and slower their germination and seedling emergence. Seedling emergence occurred from a maximum depth of 12 cm with most seedlings emerging from 2 and 4 cm depths. The percent seedling emergence, number of days of first emergence, percent seed germination and percent of dormant seeds were significantly affected by different species and burial depth. There was a significant positive correlation between the number of days to first emergence and burial depth. Both mean percent germination and percent seedling emergence were negatively correlated with depth significantly for each species (Jun Ren *et al*., 2002).

Seedling depth is influenced by the physical placement of seeds within the furrow and the amount of soil cover. Both the vertical seed spread and the uniformity of soil cover will influence the final variation in seedling depth. While seed boot design, and setting and matching to point type dictates the quality of seed placement, this is only half of the equation. Seed covering is another significant factor. A more uniform seedling depth is typically achieved with press wheels, which minimize variation in soil cover, provided they leave a regular and stable furrow. At the implement level, significant variation in seeding depth (20 to 60 millimeters) can be created with many seeding systems due to lateral soil throw between adjacent rows (Desbiolles, 2002).

Influence of soil factor on germination of seeds is based on transmittance of light through the soil, which includes particle size, moisture content, particle colour and presence of organic matter (Tester and Morris, 1987). Studies have noted the decrease in soil transmittance with decreased particle size (Bliss and Smith, 1985). However, there have been no detailed measurements of the penetration of light through soil mixtures of widely different particle sizes, as would often be found in field situations. Depending on the soil type, moisture content either increases or decreases the light transmittance of the soil. When sand is saturated the transmittance will increase, whereas saturation of clay and loam decreases the transmittance of light. This difference is probably attributed to a reduction in the reflection of light by the soil particles (Oziegbe *et al.*, 2010).

Benvenuti, (1995), Benvenuti and Macchia (1998) were reported that the seeds of various plant species required light and oxygen for maximum germination. Benvenuti and Macchia, (1995, 1997) were also investigated that Oxygen was required for seed germination, but Rumpho and Kennedy, (1981) observed that number of seeds may germinate in the absence of oxygen. Gutterman *et al*., (1992) reported that most seed were able to germinate at 15% oxygen and that higher oxygen concentration. Benvenuti and Macchia, (1995) also found that hypoxia decreased seed germination and rate of germination, Oxygen concentrations within the soil decline with depth (Topp *et al*., 2000). High soil moisture soil compaction high microbial activity or poor soil structure may decrease soil oxygen concentration or inhibit gaseous movement within the soil (Drew, 1990, Hodgson and Macleod, 1989; Ishii and Kadoya, 1991). The range of depth from which weed species may emerge in dependent on the species and soil physical parameter with in the agricultural fields in western Canada most weeds emerge from the top 4cm of the soil profile. The seed size is well related to planting depth. In dry conditions, deep planting might be successful in crop emergence. Liu *et al*., (2007) suggested the relationships between seed shape and plant frequency and density were positive for each meadow use type, but were negative for each sand dune type. For normal conditions, depending on soil and weather conditions, an ideal planting depth is 2cm deep. Keeping in view, the importance of depth and soil texture, the present study was carried out to investigate the following two objectives:

- Role of soil texture in seed germination.
- Effects of seed sowing depths on emergence of seeds.

MATERIALS AND METHODS

Soil samples

Visually observed clay loam and sandy loam soil samples were collected from different habitats of the Dera Ghazi Khan into 5 replicates, respectively. All the soil samples were taken into polythene bags and fully labeled. After confirming the soil texture of collected samples by the Soil and Water Testing Laboratory Dera Ghazi Khan, then they were used for further experimental work.

Source of weed seed

Seeds were collected from the different natural habitats of Dera Ghazi Khan. The collection was done at the ripening stage of various weeds in the month of March and April during the year 2009. These seeds were kept into paper bag and fully labeled. The six types of weed seeds were selected to test the hypothesis, 2 species from Fabaceae family, two from Poaceae and 1, 1 species from Fumariaceae and Rubiaceae, respectively. Seeds Images were taken with the help of Digital Camera (Figure-2).

The germination procedure

The germination experiment was conducted at the glass house of Botany Department Government College Dera Ghazi Khan from mid March- mid April, 2010. The set-up consisted of 180 earthen pots with a diameter 10 inches and a depth of 12 inches. All Pots were filled with clay loam soil, characteristics, EC = 379.4x 10^6 m moles /L, pH = 8.04 and Organic Matter = 0.65% (Table-3) and sandy loam soil, characteristics EC = 154x 10^6mmoles/L, pH =7.7 and Organic Matter = 1.57% (Table-4). Each pot was fully labeled according to depths and soil texture (sandy loam and clay loam). Total 1800 healthy seeds of six weeds belonging to Fabaceae Fumariaceae, Poaceae and Rubiaceae families were selected for germination trial at the depths of 2cm, 4cm and 6cm with in 5 replicates. Each replicates were containing 10 seeds from each species. Seed were sown at 2 cm, 4cm, and 6cm depths in both the texture class of soil. All pots were arranged in the glass house in such a way that all pots had equal access to water. Pots were placed in the glass house in a completely randomized block design, and spaced evenly apart. The emergence of seeds in all the pots checked daily. A total count was made at the end of 25 days.

Statistical analysis

The data obtained from experiment was followed by Steel and Torrie (1996) for statistical analysis.

RESULTS

The results from germination experiment depicted that the six types of weed seeds showed maximum germination at 2cm depth and sandy loam texture soil. *Avena fatua* L. and *Vicia sativa* L. showed significantly more germination i.e., 46±3.69, 48±3.85 respectively than the remaining four other types of weed seeds (Table-1). The lowest germination i.e., 20±1.59 was found in the case of *Galium aparine* L.

The results from Pearson correlation among the species, depths and soil texture class (Table-2, P<000*) showed that the significant negatively decrease of seed germination with the increase of seed sowing depths and seed emergence positively increased orderly from clay loam texture soil characteristics (Table-3) to sandy loam texture soil characteristics (Table-4) In this document sandy loam textured soil and 2cm sowing depths was fit for maximum seed emergence in various species of weeds. The graphical representation was showed that increasing the sowing depths of seeds, decreasing the emergence of seeds significantly (Figure-1). In addition to seed depths soil texture play a key role in the maximum germination of seeds. The soil having good porosity and more organic content was the best for seed emergence, because due to porosity the seed get maximum oxygen, which is necessary for seed germination metabolism. However seed shape had not significant role in the germination process (Figure-2).

DISCUSSIONS

Soil texture class and sowing depths of seeds play an important role in the emergence of seeds. In this investigation the main focus of our experiment was that, to test the idea for seed emergence at various depths and communicate the appropriate method of germination to the layman grower. Often the farmers have not a good knowledge about the soil condition and the suitable sowing depth of seeds; due to lack of awareness about germination criteria unsuccessfully they failed to get maximum seedlings in the fields. So from this study, we were trying to convey our observation to the growers that

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before they were sowing the seeds of crops or any species, the cultivator know very well about the texture of the soil and seed sowing depths for obtaining the maximum seedling growth. This finding is also a supporting document for other findings, which are available in the different literature of the world e.g. Malik *et al*., (2007); Benvenuti, *et al*., (2001); Du Croix Sisson *et al*., (2000); Lambert *et al*., (1990); Scott *et al*., (1985); Watt and Whalley, (1982) were investigated that the sowing depth surprisingly affects seedling emergence, which is species dependent. Moreover, Hodkinsan *et al.,* (1998); Cussans *et al*., (1996); Thompson *et al*., (1993) and Michaels *et al*., (1988) all were investigated separately and different parameters but their exploration were focused on correlation among seed depth, seed shape and soil texture. Similarly our findings will support the various literatures in future.

Table-1. Total actual seed emergence of different weed species in clay loam and sandy loam soil into 5 replicates at various depths with standard deviation.

Name of species	Total seed emergence in clay loam soil ±SD at various depths			Total seed emergence in sandy loam soil ±SD at various depths		
	2 cm	4cm	6cm	2 cm	4cm	6 cm
Avena fatua Linn.	36±2.88	32±2.56	25±1.99	46±3.69	40±3.20	28±2.24
Fumaria indica Hausk	32±2.56	28±2.24	23±1.83	38±3.04	34±2.72	26±2.06
Galium aparine Linn.	28±2.25	26±2.08	20±1.59	36±2.89	30±2.40	24±1.91
Medicago denticulata Willd.	30±2.41	28±2.24	22±1.75	38±3.05	32±2.56	26±2.07
Phalaris minor Retz.	30±2.41	25±2.00	26±2.16	40±3.21	34±2.72	27±2.15
Vicia sativa Linn.	38±3.05	32±2.56	28±2.23	48±3.85	43±3.45	30±2.38

Table-2. Pearson correlation among the species, depths and soil texture.

Variables	Species	Depths	Soil texture
depths	0.100 0.182		
Soil texture	-0.005 0.952	0.068 0.363	
Seed emergence	0.053 0.480	-0.627 0.000***	0.381 0.000***

(P< 000***Level of significance at 0.05%)

Table-3. Clay loam soil properties into 5 replicates.

Clay loam soil samples	ECx10^6 mmoles/L	pH	Organic matter %	$Ca^{++}+Mg^{++}$/ meq/l	Saturation %
1	453	8.4	0.69	3.80	46
2	306	8.1	0.56	3.30	55
3	408	6.9	0.72	4.00	58
4	370	8.5	0.67	2.90	60
5	360	8.3	0.62	2.83	58
Mean	379.4	8.04	0.652	3.36	55.4

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Table-4. Sandy loam soil properties into 5 replicates.

Sandy loam soil samples	ECx10^6 mmoles/L	pH	Organic matter %	$Ca^{++}+Mg^{++}$/ meq/l	Saturation %
1	140	8.1	0.18	4.10	28
2	132	8.8	0.71	2.84	32
3	166	6.8	2.0	3.80	21
4	160	7.4	1.60	4.20	23
5	172	7.6	1.14	4.90	26
Mean	154	7.7	1.57	3.97	26

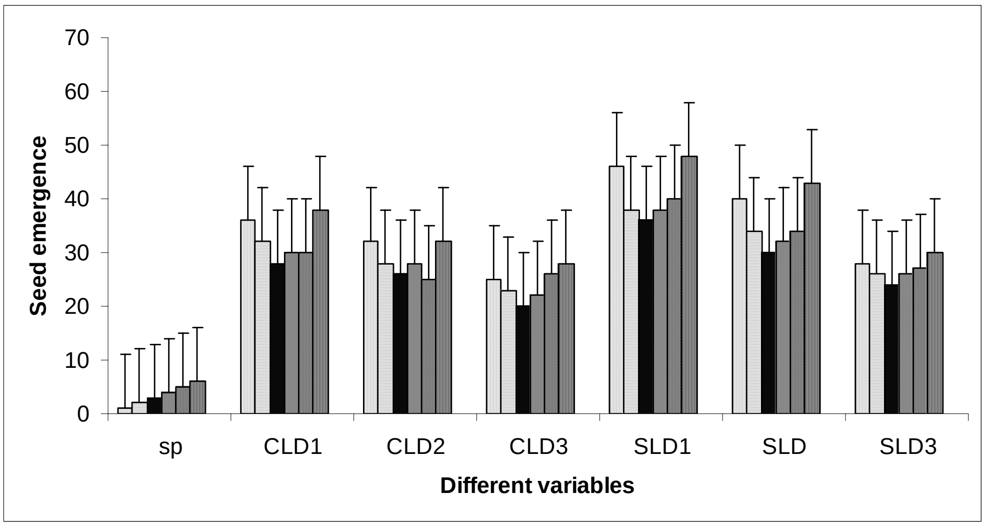

Figure-1. Graph between seed different variables (species, soil texture and sowing depths) and seed emergence of weed species.

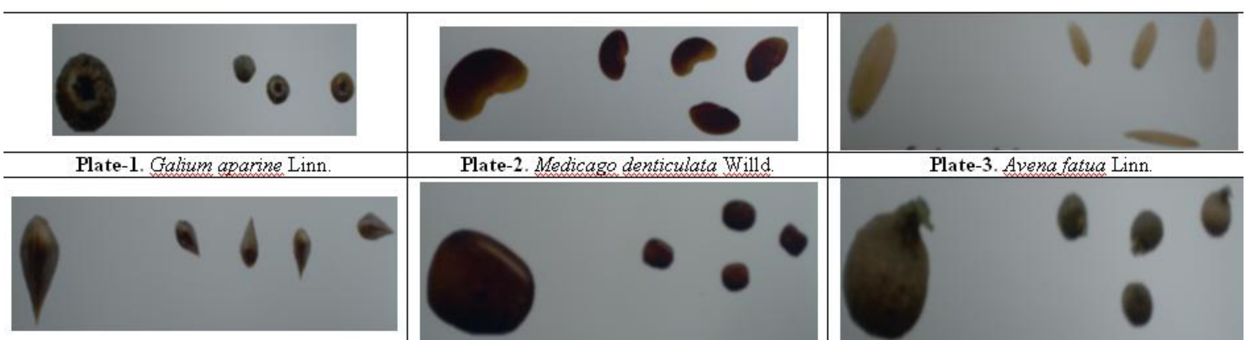

Plate-1. *Galium aparine* Linn. **Plate-2.** *Medicago denticulata* Willd. **Plate-3.** *Avena fatua* Linn.
Plate-4. *Phalaris minor* Retz. **Plate-5.** *Vicia sativa* Linn. **Plate-6.** *Fumaria indica* Hausk.

Figure-2. Seeds' shapes of weed species used in germination experiment.

CONCLUSIONS

From this study it was concluded that the good texture soil and appropriate seed sowing depths play an important role in the emergence of various seeds of different species. But the shapes of seed yet not play a role in germination.

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