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AGRONOMY

Weed seeds stratification in contrasting soil texture on the bank of river godavari

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Abstract

The experiment was conducted at Central Tobacco Research Institute (CTRI), Rajahmundry, Andra Pradesh, 2013 to investigate the role of soil texture in weed seed germination and effect of depth of soil profile on emergence of weed seeds. The soil samples were collected from 3 places viz. Rajahmundry, Katheru farm under CTRI both belong to East Godavari district and Chainnaigudem village in West Godavari district with sandy, clay and sandy loam in texture respectively. Soil samples were collected from 0-10, 10-20, 20-30 and 30-40 cm depth of soil profile using core sampler. Each site represents were approximately 1300 m^2 area and 32 samples from 4 depths for every site. So, total 144 samples were collected to conduct the experiment. Germinated weeds identified and counted every week and 10 weeks study was carried out. Sandy, sandy loam and clay soil texture found significant non-linear relationship between weed germination and soil depth. All three places recorded significant interaction between depth and seed germination. Soil depth upto 20 cm recorded maximum weed emergence both monocotyledonous and dicotyledonous; however, dicotyledonous weeds recorded more in number than monocotyledon in four consecutive depths. Sandy soil found highest number of germinated weeds than sandy loam and clay texture soils.

Highlights

- Soil texture sandy, sandy loam and clay found significant non-linear relationship between weed seeds germinated and soil depth
- Soil depth upto 20 cm found maximum weed emergence both monocotyledon and dicotyledonous and sandy soil found highest number of germinated weeds than sandy loam and clay texture soils.

Keywords: Germinated, weed seeds, non-linear relationship, soil texture, monocotyledon, dicotyledonous

Weeds have been existing on the earth ever since the man started crop cultivation and recognised as a problem. Since then the battle against weeds is never ending and it requires one and often the costliest agronomic inputs for success in crop production. It affects both quantity and quality of crop produce. Yaduraju (2006) reported that in India, weeds contribute highest (37%) annual yield losses of agricultural produce as compared to that of insects (29%), diseases (22%) or other pests (12%). Annual weeds ensure their survival through production of large quantity of seeds within a short period of time which disperse through different means viz. crop admixture, manure, animals, wind, water and agrochemicals. Weed seeds bank includes both recently added and older seeds that have been

stratified in soil since several years. Some weed seeds may remain alive for longer period in defiance of unfavourable condition and most of them germinate whenever get favourable condition. Baskin *et al.* (2004) reviewed that a dormant seed does not have the capacity to germinate in specified period of time under any combination of normal physical environmental factors that are otherwise favourable for its germination.

Several factors influence weed seeds germination, above all soil temperature and moisture, light intensity and the physiological aspects of weed seeds. In any case the composition of soil plays an important role in the germination mechanism of seeds of various plants species. Seeds of individual species were most abundant in the aggregate size class most closely matching its seed size and it associated with soil aggregates larger than 9 mm (Reuss *et al.* 2001). Hence, investigating the soil's weed seeds stratification is a mat er of serious concern because it provides evidence weed density and composition which may allow forecast on future weed problem and by the support of this information effective and economic weed management strategies can be formulated in lieu of alone chemical control which is both ecological and environmental concern. With a view to the importance of depth and soil texture the present study was carried out to investigate the role of soil texture in seed germination and effect of seed sowing depth on emergence on seeds.

Material and Methods

The experiment was conducted at CTRI, Rajahmundry, Andhra Pradesh in 2013. The soilsamples were collected from three places which is different in texture (Rajahmundry in East Godavari district, Chinnaigudem village in West Godavari district and Katheru farm under CTRI in East Godavari district on the bank of Godavari River with sandy, sandy loam and clay in texture respectively) in Andra Pradesh. These three places mainly used for cultivation of Flue Cured Virginia tobacco. Soil samples were collected from 0-10, 10-20,20-30 and 30-40 cm depth of soil profile from all the fields using core sampler. For each place three sites were selected with approximately 1300 m^2 area for each site to collect soil samples. From each site 32 samples were collected from 4 depths and each two samples with same depth were mixed to found 16 samples which represent 10cm×10 cm area for every depth of soil profile. So, total 144 samples were collected to conduct the experiment. Collected soil samples were separately passed through a 2 mm sieve to remove unwanted vegetation materials and stones. Then soil samples were spread in plastic trays for germination. Soil samples in plastic trays were supplied with water regularly to keep the soil moisture nearly at field capacity throughout the course of the experiment for 10 weeks. At weekly intervals germinated weed seeds were identified, counted and then soil was turned to allow remaining weed seeds for germination. Total number of emerged weeds were considered as transient weed seed-bank and expressed as number per $0.01m^{-2}$. The total weeds emerged were calculated using non-linear relationship for every soil texture. Again monocotyledon and dicotyledon weeds wereanalysed using FRBD design with 4 soil depths (0-10, 10-20, 20-30 and 30-40 cm) and three places as factor (Rajmundry, Chinnaigudem and Katheru) with three site for every places as replication. Actual data were transformed using square root transformation before ANOVA to increase homogeneity of error variance.

Results and Discussion

Soil texture and depth play an important role in the emergence of weed seeds. The place and depth of soil had significant effect on the monocotyledonous and dicotyledonous weed emergence at all three places. Place Rajahmundry which is sandy in soil texture recorded highest emergence from all depths forboth monocotyledonous and dicotyledonous weeds of the collected soil samples compared to rest two places Channaigudem and Katheru, sandy loam and clay in texture respectively (Table 1). Soil properties such as physical, chemical and biological had an impact on the distribution of weed seeds in soil profile. Sandy, sandy loam and clay soil texture found significant non-linear relationship with soil depth. Soil depth up to 20 cm recorded maximum weed emergence

Table 1. Effect of place and depth on weed seeds ($0.01m^{-2}$) emergence in soil profile.

Site/Depth	0-10 cm		10-20 cm		20-30 cm		30-40 cm	
	M	D	M	D	M	D	M	D
Rajahmundry	260.25 (16.14)	626.75 (25)	108.25 (10.42)	339 (18.35)	48 (6.93)	165 (12.63)	29 (5.37)	81 (8.88)
Chinnaigudem	166.75 (12.87)	249.75 (15.02)	36 (5.85)	64.25 (8.01)	12.25 (3.49)	8 (2.62)	3.75 (1.93)	3.5 (1.88)
Katheru	9 (3.02)	32.25 (5.71)	3.25 (1.76)	13.25 (3.41)	0.5 (0.97)	4.5 (2.07)	0 (0.71)	0.25 (0.84)
LSD 0.05								
		M				D		
Effect of place/ depth		0.35				0.60		
Interaction between place and depth		0.41				0.69		

Note: Data subjected to transformation and figures in parentheses are original values

Legend: M- Monocotyledonous, D- Dicotyledonous

both monocot and dicot though dicot found more in number than monocot in four consecutive depths. Both monocotyledon and dicotyledonous weed emergence showed gradual decreasing emergence with increasing soil depth. But least number of weedemergences wasrecorded in soil depth 30-40 cm which remained beyond undisturbed by ploughing (Table 1). High soil moisture, soil compaction, high microbial activity of poor soil structure may decrease soil oxygen concentration or inhibit gaseous movement within the soil reduced weed seeds germination (Drew 1990). Farming system also influence weed seeds composition. Boguzas *et al.* (2004) recorded that six years organic farming the weed seeds of *Chenopodium album*, *Fallopia convolvulus* and *Stelleria media* have been found in 0-25 cm soil layer for 5 years but at six years 26.3, 70.6 and 91.2% lees seeds of mentioned species respectively than transition period. Organic and integrated cropping contribute seed bank 5000-6000 per square metre weed seeds higher than conventional and high input-cropping system about 2000 seeds per square metre and also found weed seeds 6300 per square metre in continue winter wheat cultivation which was higher than crop rotation practices about 5000 seeds per square per metre (Alireza *et al.* 2009). Cultural practices that are ploughing, harrowing, weed management practices affect weed seeds distribution in soil profile. Sumith *et al.* (2009) recorded ploughing and harrowing significantly reduced the seed bank of 30 cm soil depth in coconut plantation and also found shifted significant numbers of weed seeds to deeper soil profile.

Weed germination was influence by the depth of soil from it germinated. Mohler (1993) reviewed that the non-linear relationship between soil depth and seed germination. However, top soil of cultivated zone recordedmaximum germinated weeds than undisturbed soil frofile.Jun Ren *et al.* (2002) determined the effects of sand burial on seed germination and seedling emergence of ten *Calligonum* L. species and found that deeper the seeds in sand the lower and slower their germination and seedling emergence. With increasing depth of soil, the number of weed emergence decreased. Maximum weeds i.e. 80-90 % emerged from the top 0-20 cm of soil profile which is the root zone of most cultivated crops where ploughing and all cultural practices performed (Swanton *et al.* 2000). Beyond the root zone i.e. 20 cm onwards emergence of weeds reduced. Few weed seeds deposited during deep ploughing remain alive and rest decayed and preyed

by micro-organism; hence, viability is lost or has dormancy. Chantre *et al.* (2009) recorded that weed seeds burial of *Lithospermumarvense* germinated 55-65% for shallow (2 cm) and 5-30% for greater depths (20 cm) and enforced dormancy levels found significantly higher among deeper seeds. Cultural practices including intercultural crop operation done in top soil recorded large variability (Ortega *et al.* 2003) because after mature seeds fall on surface buried by cultural practices and remained dormant for long time. Germination of weeds also depends upon the weed seeds characteristics and vegetation composition in site. Mutual relationship between size, shape and seed germination are complex and specific to each weed (Grundy et al.2003).

Weed seed movement in soil and germination were affected by soil physical properties such as soil texture, structure etc. Benvenuti (2007) found that vertical movement of weed seed was much slower in clay soils (2% > 6 mm) than sandy soil (10% > 6mm). Sandy soil recorded highest number of germinated weed seeds forboth monocotyledonous and dicotyledonous weeds than rest two soil texture viz. sandy loam and clay (Figure 1). Clay content in soil enhanced decomposition and dormancy of weed seeds present in soil profile. Hoyle *et al.* (2013) recorded significant interaction between weed species and soil texture and for all weed species and soil texture viz. sand, loamy sand and clay loam, emergence decreased as planting depth increased with the greatest percent emergence at the soil profile. Soil organic matter application also plays an important role the survival of weed seeds in soil profile. Ayongwa *et al.* (2011) found that incorporation of organic matter in soil depressed seed survival of *Strigahermonthica.*

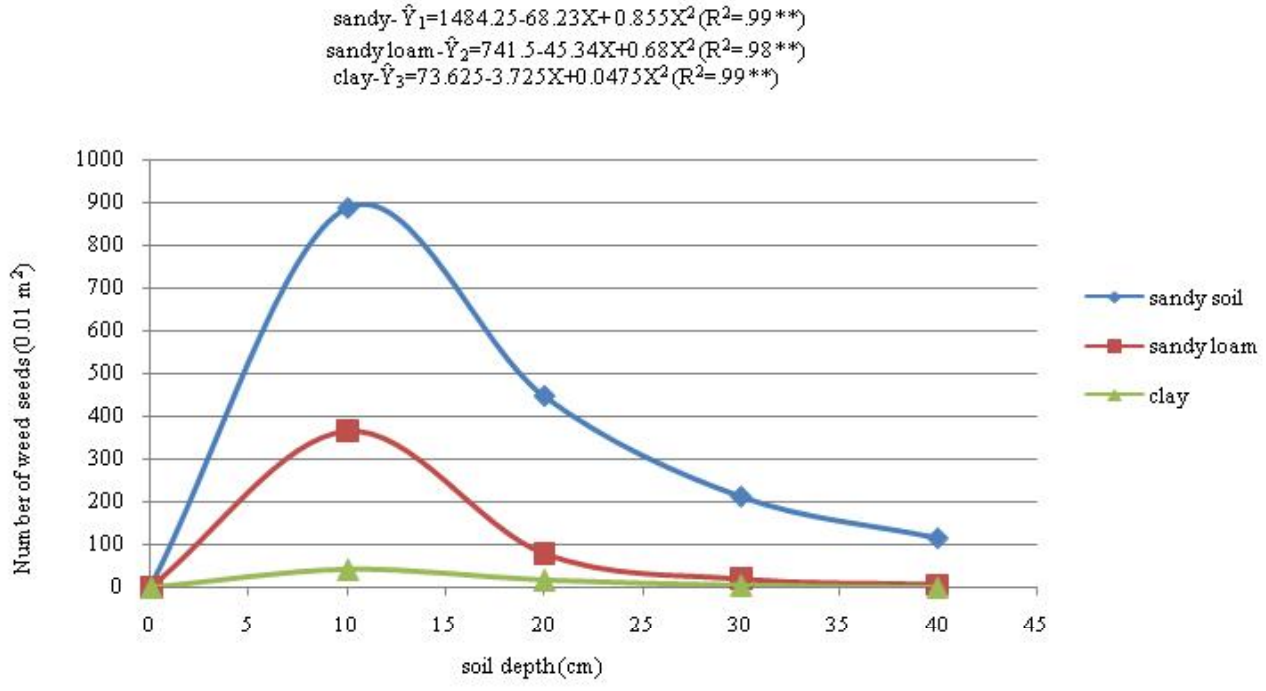

Fig. 1. An estimated non-linear relationship between total numbers of weed seeds germinated and soil depth of three soil texture

Conclusion

Though most of the weed seeds germinated within 60 days after incubation and weeds germinated within this period in field are economically important. All the same some weed seeds might remain dormant. Majority of weed seeds germinated from top 0-20 cm depth of soil and both sandy and sandy loam texture were uniform seed stratification than clay in texture soil.

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