https://doi.org/10.29321/MAJ.10.A03199

Madras agric. J. 64 (6) : 351—354, June, 1977

Effect of Soil Compaction and Depth of Seed Placement on the Emergence of Different Crops

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Compacting the soil above 1.2 g/cc delayed the crop emergence and reduced the emergence percentage of seedlings. At shallow sowing wheat tolerated a bulk density of 1.2 g/cc and rice upto 1.8 g/cc. Increasing seeding depth had harmful effect on crop emergence.

Manjura *et al.* (1966) reported that surface compaction produced by wheels exerting a pressure of 0.6 to 2.65 psi reduced cotton emergence, the reduction increasing with increasing pressure. Clement (1964), from pot experiments, found that mechanical compaction of moist soil over wheat seed severely inhibited germination. Varade and Ghildyal (1968), from the laboratory experiments, indicated that plumule emergence of seeds upto 8 cm depth was not affected until bulk density reached 1.7 g/cc. With bulk densities of 1.7 to 1.8 g/cc emergence was reduced to 70 per cent at 3 cm depth and ceased at 10 cm depth. The use of heavy farm machinery is increasing day by day in India. It was very essential to have basic information on the soil compaction and its effect on emergence of crops. Hence study of these parameters would provide basic information essential for creating an ideal environment for emergence and growth of seedlings.

MATERIAL AND METHODS

The present investigation was carried out under laboratory conditions during 1972 in a randomised block design. The treatments consisted of five levels of bulk density and five seeding depths replicated three times. The various levels of bulk density were: 1.1, 1.2, 1.4, 1.6 and 1.8 g/cc and the seeding depths were 2, 4, 6, 8 and 10 cm respectively. The crops and their varieties used in the present investigation were (i) Rice (Padma) and (ii) wheat (Kalyan Sona).

Aluminium cans of 10.5 cm diameter and 13 cm height were used for studying the seedling emergence. The soil was collected from the upper 22 cm layer from the Agronomy Farm, College of Agriculture, Akola. It was air dried, then the soil lumps were broken into smaller pieces and finally it was made into a fine powder. The crushed soil was sieved through a 4 mm sieve and moisture content was determined on oven dry basis. The moisture percentage was 2.9. The Physical and chemical properties of the soil are given in Table 1. The weighed amount of soil was compacted in the cans layer by layer with the help of a pestle so as to get

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TABLE I Physical and Chemical properties of the soil

Properties	Per cent
Coarse sand	3.6
Fine sand	10.4
Silt	36.6
Clay	49.4
Field capacity	36.0
Wilting point	18.5
Water holding capacity	60.3
Organic carbon	0.42
Hydraulic conductivity	0.26 cm per min.
pH	7.8

uniform compaction. In each can 10 seeds were placed at the required depth and the remaining amount of soil was transferred to the can over the seeds and compacted. After compaction a measured quantity of water was applied to each can to bring the soil to field capacity. The moisture was maintained throughout the experimental period (one month) by daily application of water equal to the deficit. The seedling emergence observations were recorded till 12th day after sowing. The data obtained were analysed statistically.

RESULTS AND DISCUSSION

The data presented in Table II indicate that the emergence of rice was delayed as the bulk density of soil and depth of sowing was increased. Increase in bulk density beyond 1.2 was found to delay emergence and this effect was further intensified with increased depth of sowing. This observation was in conformity with the findings of Varade and Ghildyal (1968). The seeds sown deeper than four cm in case of 1.8 bulk density could not emerge. At low

TABLE II. Number of days required for emergence of rice

Depth of	BULK DENSITY (g/cc)				
Sowing cm	1.1	1.2	1.4	1.6	1.8
2	4.0	4.0	5.0	6.0	7.0
4	4.0	4.0	6.0	7.0	10.0
6	5.0	5.0	7.0	9.0	—
8	6.0	5.0	9.0	11.0	—
10	—	—	—	—	—
C.D. (5%)	0.3				

bulk densities (1.1 and 1.2), increasing the depth of sowing from 2 to 4 cm did not show a difference in the number of days to emerge but with further increase in depth of sowing resulted in significant delay in emergence. At 10 cm depth of sowing there was no emergence of rice at all at any of the bulk densities of soil.

The data regarding the emergence of rice is given in Table III. Increasing bulk density beyond 1.2 with 2 and 4cm depth of sowing and beyond 1.4 with 6 and 8 cm depth of sowing reduced the emergence percentage significantly. Wanjura *et al* (1966) noted the inhibitory effect of soil compaction on emergence percentage.

Number of days required for emergence of Wheat: With every successive increase in bluk density there was a significant delay in the emergence of wheat (Table IV). Only three days were required to emerge when bulk density was 1.2, while more than 12 days were required when bulk density was 1.8. Clement (1964) found that mechanical compaction of moist soil over wheat seed severely inhibited germination and no plants emerged

TABLE III. Mean emergence percentage of rice seedlings

Depth of sowing (cm)	Bulk Density (g/cc)					Mean
	1.1	1.2	1.4	1.6	1.8	
2	64.6 (81.6)	63.9 (80.7)	52.7 (63.6)	52.7 (63.6)	46.9 (53.3)	55.9 (68.6)
4	70.1 (88.4)	61.2 (76.8)	43.1 (46.7)	28.7 (23.1)	23.8 (16.3)	45.3 (50.6)
6	36.9 (36.1)	41.1 (43.9)	39.2 (40.0)	26.1 (19.4)	0.0 (0.0)	28.6 (22.9)
8	28.7 (23.1)	28.7 (23.1)	28.7 (23.1)	18.4 (10.3)	0.0 (0.0)	20 9 (12.7)
10	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Mean	40.1 (41.5)	39.0 (39.6)	32.7 (29.2)	25.2 (18.1)	14.1 (6.0)	
C.D. (5%)	9.1					

(Figures in the parantheses are the original values)

TABLE-IV. Days required for emergence of wheat

Bulk Density (g/cc)	Days required for emergence	Depth of sowing (cm)	Days required for emergence
1.1	3.6	2	3.3
1.2	3.0	4	4.3
1.4	6.0	6	6.0
1.6	10.0	8	6.0
1.8	12.6	10	—
C. D. (5%)	0.6		0.6

from a compacted clay loam. As regards the depth of sowing, it was observed that with increasing the depths of sowing, the emergence was delayed. At 10 cm sowing depth, wheat could not emerge.

Emergence percentage of wheat: Emergence percentage of wheat was severely affected due to increase in bulk density and depth of sowing Table-V). Increasing bulk density beyond 1.2

TABLE V. Data on the emergence percentage of wheat

Depth of Sowing (cm)	BULK DENSITY (g/cc)					Mean
	1.1	1.2	1.4	1.6	1.8	
2	77.7 (95.5)	61.2 (76.8)	28.0 (23.2)	18.4 (10.0)	18.4 (10.0)	40.9 (42.9)
4	61.9 (77.8)	72.7 (91.2)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	26.9 (20.5)
6	0.0 (0.0)	63.9 (80.6)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	12.7 (4.8)
8	0.0 (0.0)	18.4 (10.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	3.6 (0.4)
10	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Mean	27.9 (21.9)	43.2 (46.8)	5.7 (1.6)	3.6 (0.4)	0.0 (0.4)	
C. D. (5%)	7.5					

(Figures in the parantheses are the original values)

resulted in total failure of emergence at more than two cm depth of sowing. Even at 1.1 bulk density there was no emergence, if sowing was done deeper than four cm. At 10 cm depth of sowing, there was no emergence at any bulk density of soil. These findings are in harmony with the results of Clement (1964).

The first author is is highly greatful to Dr. B.G. Bathkal, Head of the Department of Agronomy, Punjabrao Krishi Vidyapeeth, Akola for providing the facilities during the course of investigation, and to the Indian Council of Agricultural Research, for awarding a Junior Research Fellowship.

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