Emergence of improved varieties of maize (*Zea mays* L.) as affected by different soil types and planting depths in Chitwan, Nepal

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Abstract

Improved open pollinated maize (*Zea mays* L.) varieties exhibit different emergence reaction as a result of either inferior seed quality or affected by agronomic practices of maize planting. To address problem of low emergence percentage of maize varieties, an experiment was laid out in factorial design under two types of soil (red clay and sandy loam), three level of depth of sowing (7, 14 and 21 cm) for Rampur Composite, Manakamana-1 and Arun-2 maize varieties in Rampur, Chitwan for representing main season (May-August). The result of the experiment revealed that emergence count was highly significant for soil types and depth of sowing among the maize varieties tested. Manakamana-1 expressed lowest percentage (20 and 29%) followed by Arun-2 (22 and 33%) and Rampur Composite (24 and 39%) of emergence under red clay and sandy loam soils, respectively. Likewise, emergence count at 10 days after sowing was recorded highly significant for depth of showing indicating that irrespective of varieties higher the planting depth lower the emergence count.. There was a positive relation between depth of planting and length of mesocotyle resulting loss of seed vigor which furnished low emergence of the maize varieties. It is suggested that depth of sowing affect emergence percentage which consequently have effects on plant population maintenance. Hence, it was concluded that sowing below 7cm deep is not feasible for the tested varieties under red clay and sandy loam soils.

Key words: Emergence, soil types, planting depths, improved varieties

Introduction

Maize is grown in almost every part of Nepal. It is used for various purposes by making flour, corn grit, roasted corn, oil extraction, and mainly as animal feed for making different ration composition as well as stover and husk as fresh and dried fodder. There are other uses of maize such as making local mats from the husk, shelled cobs as fuel wood and local beverage production by most of the ethnic communities in the hills and terai. Therefore, maize is a multipurpose crop of Nepal. These days, maize being a C4 plant importance of maize has been increased in global temperature rise to sustain for higher temperature because of its photosynthetic capacity to utilize *PEPcase*, an enzyme effectively to reuse trapped carbon molecule for effective photosynthetic activity under elevated temperature. It has been regularly reported from some of the hilly districts that emergence percentage of improved variety of maize such as Manakamana-1 has encountered low emergence percentage in farmers' field.

Low emergence may be by virtue of soil types, seed quality, depth of sowing, low early seed vigor, and many other biotic and abiotic factors. Thus the case of low emergence and its interacting role need special attention which is a research issue which helps farmers' adjustment on sowing depth, choice of variety based on soil types in order to sustain plant population for increased production. With an idea to know the germination problems of three most important open pollinated varieties (OPVs) of maize, the interaction effects among variety x soil types x depth of sowing with respect to the emergence of maize was studied.

Methodology

The trial was laid out in factorial design with three replications. Two types of soil (red clay and sandy loam) were kept as main factors, three varieties viz; Manakamana-1 (Mana-1), Rampur Composite (RC), and Arun -2 as sub factors and three depth of sowing (7, 14, and 21 cm) as sub-sub factors. Two 1 m x 1 m x 9 m plots were marked to make a gross plot size of 1 m x 18 m per block and three such blocks were prepared. Sandy loam soil was the soil of Rampur farm while red clay soil was transported by tractor from the Ramnagar of Chitwan, about 15 km away from the research station. Transported and in-situ soils were compacted. Four rows of 25 cm apart were maintained per plot and 25 seeds per row were sown making 100 seeds/ variety in each soil type. These 25 seeds/ row were planted in different depths of sowing which was maintained by marking different depths in a pointed iron peg which facilitated planting in different depths. The trial was planted on 31st of May 1997. Emergence count of maize was done on 7, 10, 14, and 21 days after sowing (DAS). Counted plants were destroyed from the plots and mesocotyle length was measured by pulling whole plant on the day of emergence count of the samples. Mean was separated by performing analysis of variance (ANOVA) from the recorded data (Gomez and Gomez, 1984).

Results and discussions

The resdukt showed that soil types and depth of showing were found highly significant ($P<0.01$). However, interaction between variety x soil type and variety x soil type x depth of showing were not significant (Table 1). The emergence percentage was recorded highest on 10 DAS and at 7 cm planting depth in both the soils (Fig. 1).

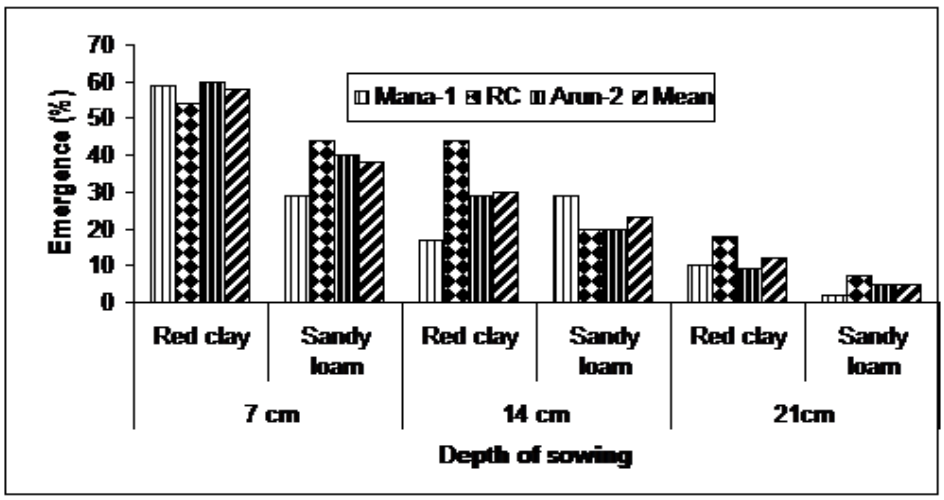

Fig. 1 Percentage of emergence of maize varieties 10 DAS planted at different depth in red clay and sandy loam soils at Rampur, Chitwan

Table 1. Complete ANOVA table of maize emergence at 10 DAS as affected by soil type x variety x depth of sowing in Agricultural Research station, Rampur, Chitwan

Sources of variation	DF	SS	MS	F value
Main Plot				
Replication	2	1024.148	512.074	
Soil (A)	1	1756.741	1756.741	157.062**
Error (A)	2	22.37	11.185	
Subplot				
Variety (B)	2	423.593	211.796	1.78 ns
AxB	2	85.147	42.573	<1.0 ns
Error (B)	8	996.26	121.157	
Sub-sub plot				
Sowing depth (C)	2	13762.481	6881.24	45.359**
AxC	2	485.815	242.90	1.601 ns
BxC	4	110.185	27.546	<1.0 ns
AxBxC	4	1267.964	336.991	2.089 ns
Error (C)	24	3640.888	151.703	
Total	53	23575.592		

Note: * significant at P<0.05, ** significant at P<0.01, and ns not-significant

However, overall germination was more on red clay soil than on sandy loam soil in all depth of sowing (Table 2). Among the varieties Manakamana-1 expressed the least emergence percentage followed by Arun-2 and Rampur Composite.

Table 2. Field level percentage of emergence of maize varieties as influenced by soil type in Rampur, Chitwan at 10 DAS)

Soil type	Mana-1	RC	Arun-2	Mean
Red clay	29	39	33	34
Sandy loam	20	24	22	32
Mean	24	32	28	

F test for soil types: highly significant at P>0.01, CV%: 12.104, LSD (P>0.05): 3.92

It was recorded from the nearby field that emergence record of the same seed lot of Manakamana-1 gave the highest emergence followed by Arun-2 and Rampur Composite (Table 3). It coincided with the findings done in the eastern hills for Manaamana-1 which was reported low emergence in clay soil (personal communication with agronomist in Pakhribas Agriculture Centre). Therefore, it is concluded that varieties are highly significant as affected by soil types and depth of sowing (Table 3).

Table 3. Percentage of emergence of maize varieties as influenced by soil type sown in different soil depths at Rampur Station, Chitwan (average of three replications at 10 DAS)

Variety/ Soil type	Depth of sowing						Mean	
	7 cm		14 cm		21cm			
	Red clay	Sandy loam	Red clay	Sandy loam	Red clay	Sandy loam	Red clay	Sandy loam
Mana-1	59	29	17	29	10	2	29	20
RC-1	54	44	44	20	18	7	39	24
Arun-2	60	40	29	20	9	5	33	22
Mean	58	38	30	23	12	5	33.6	22

F test: variety-not significant, depth of sowing-highly significant (P<0.01), CV %-44, LSD (0.05)-8.47

The data showed that there was no interaction between soil type x variety as well as soil type x variety x depth of sowing. It suggest that emergence of OPVs tested in the study was pronounced with depth of sowing indicating that deeper the depth of sowing lesser the emergence percentage and vice versa. The finding is valid irrespective of varieties and soil types in the study.

From the mesocotyle length measured for these varieties, it was found that deeper the depth of sowing longer the mesocotyle length (Richi, 1989) which is an established physiological parameter for monocotyledon seeds. This characteristic holds true for this experiment as well (Table 4). As the depth of sowing increased, the length of mesocotyle also increased resulting low emergence percentage in deeper depth of sowing (Fig. 2).

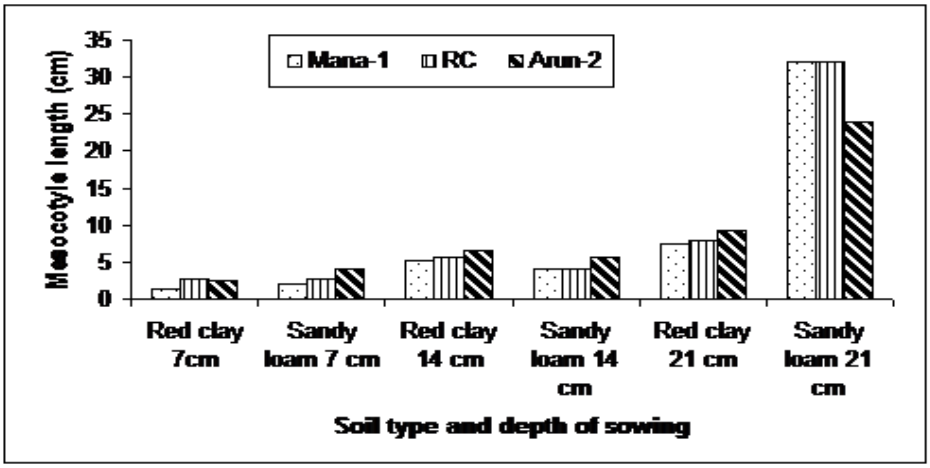

Fig. 2 Relationship between depth of sowing and mesocotyle length under red clay and sandy loam soil at Rampur, Chitwan

Table 4. Effects of different soil types and planting depths on emergence and morpho-physiological traits of three maize varieties at Rampur, Chitwan

Treatment combination	Percentage of germination				Morpho-physiological traits			
	7 DAS	10 DAS	14 DAS	21 DAS	Mesocotyle length (cm)	Plant height (cm)	No of leaves/plant	Plant vigor* (1-4)
Red soil, Mana-1, 7 cm depth	57	59	37	35	1.4	27	4	3
Red soil, RC, 7cm	50	54	32	32	2.7	31	5	4
Red soil, Arun-2, 7 cm	51	60	36	37	2.4	27	4	4
Red soil, Mana-1, 14 cm depth	15	17	12	11	5.1	25	5	1
Red soil, RC, 14cm	44	44	27	26	5.7	27	5	1
Red soil, Arun-2, 14 cm	29	29	20	22	6.5	26	5	2
Red soil, Mana-1, 21 cm depth	11	10	7	7	7.4	25	4	1
Red soil, RC, 21cm	17	18	12	11	7.9	25	5	1
Red soil, Arun-2, 21 cm	9	12	6	6	9.2	24	4	1
Sandy soil, Mana-1, 7 cm depth	30	29	23	22	2.6	29	4	3
Red soil, RC, 7cm	44	44	30	29	2.8	28	3	4
Sandy soil, Arun-2, 7 cm	36	40	29	28	4.1	30	5	4
Sandy soil, Mana-1, 14 cm depth	30	29	20	19	4.1	32	5	1
Sandy soil, R RC, 14cm	21	20	16	14	5.6	31	4	1
Sandy soil, Arun-2, 14 cm	19	20	16	15	6.1	31	4	1
Sandy soil Mana-1, 21 cm depth	2	2	2	1	6.3	34	5	1
Sandy soil RC, 21cm	8	7	5	5	8.2	32	5	1
Sandy soil, Arun-2, 21 cm	5	5	4	3	8.4	24	3	1

*1= very poor, 2=Good, 3=satisfactory, 4=excellent

It was established from this study that the field level emergence of maize varieties tested was affected due to soil types which ranged 91-100% in sandy loam soil of Rampur Chitwan and emergence was completed at 10-15 DAS (Table 4). Rampur Composite could be sown up to 15 cm depth while Manakamana-1 and Arun-2 were sensitive to sowing more than 7 cm deep. As the depth of sowing increased mesocotyle length also followed same pace resulting loss of seed vigor giving low emergence of the maize varieties. . It is suggested that depth of sowing affect emergence percentage which consequently have effects on plant population maintenance. Therefore, study of emergence percentage for different varieties in different soil condition should be established before releasing any variety for general cultivation for crop establishment is one of the yield determining factors of maize production. Field level emergence under sandy loam soil indicated that up to 15 DAS there is complete emergence of maize under Rampur condition (Table 5).

Table 5. Days required for complete emergence of maize varieties at Agricultural Research Station Rampur in sandy loan soil under field condition, Rampur, chitwan (average of three replications)

Variety/DAS	Percentage of emergence			
	7 DAS	10 DAS	15 DAS	21 DAS
Mana-1	40	95	100	100
RC-1	56	90	91	91
Arun-2	-	92	95	95

Chemical analysis of red clay and sandy loam soil indicated that soil properties were more favorable for emergence in red clay than that of sandy loam soils (Table 6).

Table 6. Some chemical properties of red clay and sandy loam soils, Rampur, Chitwan

Soil type	PH	Organic matter	Total N
Sandy loam	3.8	0.403	0.02
Red clay	5.2	1.42	0.069

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