Pakistan J. Agric. Res. Vol. 10, No. 1, 1989

WHEAT EMERGENCE UNDER LIMITED SOIL MOISTURE – EFFECT OF SEEDING DEPTH AND SEED PRE-SOAKING

Shahbaz Ahmad*, Iftikhar Ahmad and N. I. Hashmi**

ABSTRACT: Establishing adequate stands at optimum time is uncertain in the rainfed areas. Availability of soil moisture for seedling emergence is a key factor for wheat stand establishment. Seed of wheat variety "Punjab-81" was soaked in water for 0, 3, 6, 9 and 12 hours and planted at 5 and 8 cm depth at the National Agricultural Research Centre, Islamabad. Rate of emergence and total emergence was higher in 8 cm depth as compared to 5 cm seeding depth. Rate of emergence was 16.58% and 42.34% higher in 12h pre-soaked seed compared to control for 8 cm and 5 cm seeding depth, respectively. The seedling emergence was concentrated on fourth and fifth day after first emergence in 8 cm depth while it was staggered in 5 cm depth. Interaction between sowing depth and seed pre-soaking was non-significant.

Key Words: Triticum aestivum; Soil Moisture Content; Emergence; Stand Establishment; Pakistan.

INTRODUCTION

Establishing adequate stands at optimum time is important for grain yield of wheat and is uncertain in most of the rainfed wheat areas because soil moisture at planting is often marginal for plant growth (Russelle and Bolton, 1980). In Pakistan about 1/5 of the wheat crop is grown under rainfed conditions every year and stand establishment is one of the major problems of this area.

For seeds to germinate, they have to attain a specific moisture content and seeds of all crops germinate in a shorter time at high soil moisture than at low soil moisture (Doneen and McGillworay, 1943). Wheat seeds germinate when their moisture content is approximately 50% on fresh weight basis (Ashraf and Abu-Shakra, 1978). Studies reveal that the emergence rate of wheat is progressively delayed as the soil water potential is lowered from field capacity (Hanks and Throp, 1956; Hunter and Erickson, 1952). Rate of emergence is influenced by water potentials below -4.0 bars (Lindstrom et al., 1976).

Soil moisture availability is always better at deeper soil profile. Khan and Syed (1972) obtained the highest plant population of wheat varieties "C-591" and "Mexi-Pak" from 7.5 cm depth of sowing followed by 5 cm depth. Fenech and Papy (1977) concluded that the best emergence was obtained with the deepest sowing as they were the least dependent on climatic conditions.

One possible way to improve stand establishment when seeding conditions are dry is soaking the seed before sowing. Khan et al. (1979) reported that soaking the seed before seeding stimulated faster emergence and seedling growth. This initial difference was maintained by plants and resulted in significantly higher grain and straw yields over the conventional practice of seeding dry seeds.

The present study was designed to

* *Barani Agricultural College, Rawalpindi.*

** *Wheat Programme, National Agricultural Research Centre, Islamabad.*

investigate the effect of seeding depth and seed pre-soaking time on the rate and final emergence of wheat under limited soil moisture.

MATERIALS AND METHODS

Seed lots of wheat variety "Punjab-81" were soaked in water for 0, 3, 6, 9 and 12 hours at room temperature. The soaked seed lots were planted at 5 cm and 8 cm depth on a moderately calcareous, silty clay loam soil at the National Agricultural Research Centre, Islamabad during 1982-83. A basal dose of 75:50:0 kg NPK/ha fertilizer was applied before sowing. Seed rate used was 100 kg/ha. Gravimetric soil moisture content at the time of planting was 5.94% and 7.44% at 0-5 cm, and 5-8 cm soil depth, respectively. Planting was done with a mechanical drill at 25 cm row to row distance making a plot size of $6m^2$. Each plot comprised 12 rows each 2m long. The experiment was laid out in a split-plot design with four replications keeping seeding depths in the main plots and seed soaking treatments in the sub plots.

Number of seedlings emerged each day were counted for 15 days starting from the first day of emergence. Emergency Rate Index (ERI) was determined following the method described by Maguire (1962). Rain was received 50 days after planting. Total number of seedlings emerged were recorded before and after rain. The results so obtained were analyzed statistically (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Differences between seeding depths were highly significant ($P = 0.01$) for emergence rate and total emergence before and after rain (Table 1). The rate of emergence and total emergence were better at 8 cm seeding depth as compared to 5 cm seeding depth. For the seeds to germinate, they have to attain a specific moisture content (Hunter and Erickson, 1952) and seeds of all crops germinate in a shorter time at high soil moisture than at low soil moisture (Doneen and

Table 1. Means of seeding depth and seed pre-soaking effect on rate and total emergence of wheat at National Agricultural Research Centre, Islamabad during 1982-83

Depth	Emergence rate	Total emergence before rain	Total emergence after rain
8 cm	33.55a	566.60a	591.05a
5 cm	6.36b	114.20b	312.25b
Soaking			
0 h	18.36	330.13	443.13
3 h	18.55	315.88	430.50
6 h	19.60	339.75	435.25
9 h	21.08	347.75	439.63
12 h	22.11	368.50	509.75

Means followed by the same letter in a column do not differ significantly at 5% level of probability.

McGillworay, 1943). At 8 cm depth the availability of soil moisture was better so the seeds were able to imbibe water more quickly and the germination process started earlier which resulted in faster emergence and total emergence was also better. The results support the conclusion drawn by Fenech and Papy (1977) that the best results are obtained with deep sowing as they are least dependent on climatic conditions. This early emergence provides more time for growth and development of the plant which contributes to the yield.

After 50 days of planting, rain was received which increased the number of seedlings by providing more soil moisture. The rain benefitted more to the shallow seeding where the increase was 173.42% compared to 4.32% increase in deep sowing. In deep sowing most of seedlings had already emerged while the seeds had to wait for moisture supply to emerge in shallow seeding.

At 8 cm seeding depth, seedling emergence was concentrated around 4th and 5th days after first seedling emergence so the stand was more uniform whereas at the 5 cm seeding depth the seedling emergence was prolonged which resulted in non-uniform stand (Figure 1). Soil moisture availability had an effect on stand uniformity.

Soaking the seed before sowing improved the emergence rate at both the seeding depths (Table 2). By soaking the seed for 12h before seeding emergence rate improvement was 16.58% and 42.34% at 8 cm and 5 cm seeding depths, respectively. Ashraf and Abu-Shakra

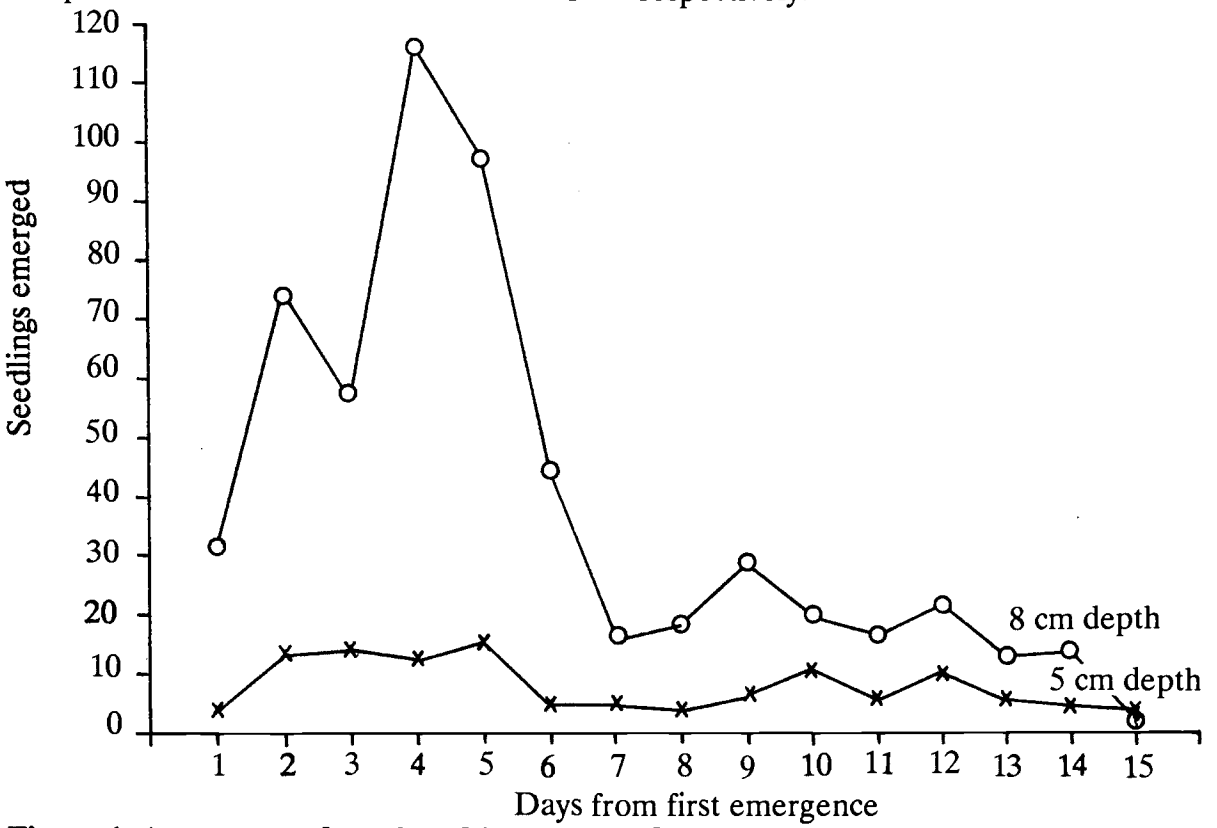

Figure 1. Average number of seedlings emerged each day starting from first emergence at two seeding depths at National Agricultural Research Centre, Islamabad during 1982-83

Table 2. Percent increase in emergence rate and total emergence by soaking the seed before seeding at two depths in wheat

Depth (cm)	Seed soaking (h)	Emergence rate		Total emergence before rain		Total emergence after rain	
		Mean	%inc	Mean	%inc	Mean	%inc
8	0	31.12	-	554.75	-	568.25	-
	3	32.01	2.87	539.50	-2.75	559.25	-1.58
	6	33.22	6.76	568.00	2.39	584.75	2.90
	9	35.12	12.84	572.50	3.20	593.00	4.36
	12	36.28	16.58	598.25	7.84	650.00	14.39
5	0	5.58	-	105.50	-	318.00	-
	3	5.08	-8.99	92.25	-12.56	301.75	-5.11
	6	5.97	7.01	111.50	5.69	285.75	-10.14
	9	7.04	26.21	123.00	16.59	286.25	-9.98
	12	7.94	42.34	138.75	31.52	369.50	16.19

(1978) reported that wheat seeds germinated when their moisture content was approximately 50% on fresh weight basis. The soaked seed had already met part of its imbibition requirement which stimulated in early emergence. There was plenty of soil moisture available at 8 cm depth to meet the seed imbibition requirement early so the seed soaking had little effect on emergence rate and total emergence. The increase in the shallow seeding was higher. The soil moisture availability was low in the shallow seeding and it took longer to fulfil the imbibition requirement resulting in a very poor emergence rate in the control plot. Studies generally reveal that the emergence rate of wheat is progressively delayed as the soil water potential is lowered from field capacity (Hanks and Throp, 1956, and Hunter and Erickson, 1952). Seed soaking had more important role to play in shallow seeding where it cut down the imbibition time and the emergence rate improvement was substantial. The results are in agreement with Khan et al. (1979) that soaking the seed before sowing stimulated faster emergence.

Rainfall is always uncertain in rainfed areas. Placing the seed deeper is preferable if available soil moisture is not sufficient in the upper soil layer for adequate stand establishment. Soaking the wheat seed in water for 12h before seeding can help in establishing early uniform stand under limited soil moisture. Both of these techniques can be used in conjunction with each other to establish an improved stand which will be capable of utilizing the available resources more efficiently and improve the yields.

LITERATURE CITED

1. Ashraf, C.M. and Abu-Shakra, S. 1978. Wheat seed germination under low temperature and moisture stress. Agron. J. 70:135-139.
2. Doneen, L.D. and McGillworay,

J.H. 1943. Germination (emergence) of vegetable seeds as affected by different soil moisture conditions. Plant Physiol. 18:524-529.

3. Fenech, J. and Papy, F. 1977. Conditions needed for successful emergence under a Mediterranean climate. The case of non-irrigated cereal crop in N. Morocco. Annales of Agronomiques, 78(6):599-635.
4. Hanks, R.J. and Throp, F.C. 1956. Seedling emergence of wheat as related to soil moisture content, bulk density, oxygen diffusion rate, and crust strength. Soil Sci. Soc. Am. Proc. 20:307-310.
5. Hunter, J.R. and Erickson, A.E., 1952. Relation of seed germination to soil moisture tension. Agron. J. 44:107-109.
6. Khan, A.M. and Syed, E.I. 1972. Optimum depth of sowing for local wheat variety C-591. Agric. Pakistan. 23: 195-203.
7. Khan, A.M. and Syed, E.I. 1972. Optimum depth of sowing for wheat variety Mexi-Pak. Agric. Pakistan 23:205-215.
8. Khan, R.A., Azeem, M. Lalah, R.A., and Ahmad, S. 1979. Crop management practices for dryland wheat. Pakistan J. Agric. Sci. 26 (1-2):7-12.
9. Lindstrom, M.J., Papendick, R.I. and Koehler, F.E. 1976. A model to predict winter wheat emergence as affected by soil temperature, water potential, and depth of planting. Agron. J. 68: 137-141.
10. Maguire, J.D. 1962. Speed of germination-Aid in selection and evaluation for seedling emergence and vigor. Crop. Sci. 2:176-177.
11. Russelle, M.P. and Bolton, F.E. 1980. Soil temperature effects on winter wheat and winter barley emergence in the field. Agron. J. 72:823-827.
12. Steel, R.G.D. and Torrie, J.H. 1980. Principles and procedures of statistics. McGraw Hill Book Inc. New York.