https://doi.org/10.29321/MAJ.10.A02742

Indian Agric. J. 69 (7): 450-455 July 1982

Analysis of Durum wheat yields in Tarai Region of Uttar Pradesh Through its Reactions to Variations in date of Seeding[1]

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Sowing *Triticum durum* wheat cv. 'Raj 911' and 'HD 4519' on seven dates (at fortnightly interval in October to January) gave enormously variable grain yields, from 25.2 to 52.0 q/ha in 1973-74 and 18.8 to 48.8 q/ha in 1974-75. Grain yield decreased by delaying sowing from November. 'HD 4519' out yielded 'Raj 911' because of higher number of spikes per unit area. Crop made little growth before maximum tillering in early sowings. In late sowings, about 90% growth was completed before ear-emergence. Nutrient (NPK) concentration in plants was lower in early sowings and higher in late sowings. Nutrient uptake, which is a function of total dry- matter produced and nutrient concentration in plants was, however, higher in early sowings and lower in late sowings.

Crop response to environment under field condition can be best studied by staggered planting over a long period of time, for the crop sown on a specified date experiences distinct environment that follows its planting. Agro-techniques for successful cultivation of durum wheat (*Triticum durum*), whose cultivation is gaining popularity in India, are not well known. This study was conducted to collect basic information on vegetative growth, development and nutrient uptake in relation to date of seeding of durum wheat varieties.

MATERIAL AND METHODS

A field experiment was conducted during winter (*Rabi*) season of 1973-74 and 1974-75 at Pantnagar (29° N, 79°E, 244 m. altitude), situated in *Tarai* belt of Shivalik range of Himalayas. climatologically, the *Tarai* belt is classified as humid subtropical The experiment was laid out with two *Triticum durum* wheat varieties viz. Raj 911 and HD 4519, sown at seven different dates at an interval of 15 days starting from 16 October. Treatments were replicated four times in split-plot design having date of sowing in main and varieties in sub-plots. Sowing was done in rows 23 cm apart and seven rows were kept in each sub-plot. weighed quantity of seed for each row was used @100 kg seed/ha.

The soil of the experimental area, was silt loam in texture, high in organic carbon, medium in phosphorus and potassium contents and neutral in reaction The crop was fertilized uniformly @ 140 kg N, 70 kg P_2O_5/ha. Half the dose of N and full P was applied as basal dose and remaining N was top-dressed at the time of first irrigation (i.e. 21 days after sowing).

Temperatures decreased from the time of first sowing (16 October) to

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December & January and increased thereafter. Lowest maximum temperature was recorded in the first week of February, 1974 and in the third week of December, 1975 and highest towards the end of April during both the seasons. The fluctuations were from 18.6 to 40.9° C in 1973-74 and 18 to 39.5° C in 1974-75. The lowest minimum temperature was recorded by the end of December and highest by the end of April in both the seasons and temperatures fluctuated from 3.5 to 19.6 °C in 1973-74 and from 6 to 19°C in 1974-75.

Dry matter accumulation was studied at maximum tillering, ear emergence and maturity stages from the plants of 1 m row which were clipped close to the ground and were dried at 70-80°C for 48 hours.

Harvesting of crop, sown on different dates, was done at proper stage of maturity as assessed by visual observations. At harvest, dried plant samples were analysed for N P K by standard methods.

RESULTS AND DISCUSSION

Dry matter accumulation :

'HD 4519', because of its high yield potential, accumulated significantly more dry matter than 'Raj 911' at all the stages (Table 1). Date of seeding affected the dry-matter accumulation significantly. Dry matter accumulation at maturity decreased with delay in sowing beyond November, in 1973-74 and October 16 in 1974-75. Regarding pattern of accumulation, in sowings done up to December 3, more than 60% dry-matter was assimilated after ear-emergence. In sowings done after this date, the percentage of dry matter accumulated till ear-emergence increased. In January 20 sowing, nearly 92% up to ear-emergence and rest 8% after ear-emergence till maturity.

At maturity 38% (35.8% in Raj 911, & 38.9% in 'HD 4519') of the whole plant dry matter was found in ear, 47% in culm and 15% (16.8% in Raj 911' & 13.8% in HD 4519) in leaves during 1973-74; but in 1974-75 ear contributed 58% (54.2 in Raj 911 & 60.3% in HD 4519) to total dry-matter, culm 27 (29.4 in Raj 911 and 26.4 in HD 4519) and leaves only 15 per cent. The variation in per cent contribution of ear to total dry-matter over a period of two years may be because the senescence of culm in 1973-74 was faster due to higher minimum temperature after third week of March which hindered the translocation of photosynthetes from culm to ear; while in 1975-74 due to lower minimum temperature the tissue of leaves and clum remained active (green) and, thus, they were able to translocate maximum part of their photosynthates towards ear.

Developmental phases :

'Raj 911' had significantly longer vegetative phase (days to ear emergence) than 'HD 4519', but the grain filling period (ear emergence to maturity) was longer in 'HD 4519' (Table 2).

Days taken to maturity and grain-filling period decreased when sowing was extended from October 16. The reduction, however was more in sowings done after November because the crops of Decem-

ber and January sowings were forced to maturity without completing their normal development due to prevalance of high temperature (Max. being more than 35°C and min. more than 14°C) during later parts of their growth. Suri and Singh (1970), Sengupta *et al* (1971) (1972) also observed decrease in maturity period with delay in sowing from November.

Yield and yield attributes :

Variety 'HD 4519' yielded significantly higher than 'Raj 911' during both the seasons (Table 3), unit area, which correlated significantly (Table 4) with grain yield of this variety but not of 'Raj 911'. In rest yield contributing characters, 'Raj 911' proved superior than 'HD 4519'. But because of lower population of ears per unit area, its yield could not come up at par with that of 'HD 4519'.

Delay in sowing after November lowered the yield significantly because it was the result of higher temperatures prevailed during the ripening period Daily maximum temperature between 28-32°C during 3 to 4 weeks after flowering resulted in premature ripening of wheat grain (Hopkins, 1935). Usually when temperatures are higher the rate of photosynthesis fails to keep pace with the rate of respiration which results in lower net assimilation (Meyer & Anderson, 1952) and hence the lower yield per hectare.

Nutrient concentration and accumulation :

Concentration of NPK in plants increased with delaying the sowing and the maximum concentration was observed in January sown crop (Table 5). This was because the temperatures in whoile lifecycle of January crops was highrer, which accelerated the nutrient uptake by plants. Both passive and active absorption are affected by temperature changes (Sutcliffe, 1962). The rate of free diffusion depends upon the kinetic energy of the diffusion molecule which is in turn dependent upon temperature. Therefore, low temperature will slow down any process dependent upon free diffusion. Low temperature also slow down the biochemical reactions found in active transport (Devlin, 1962), and thus, the concentration of nutrients in early October & November) sowings was less due to relatively low temperature during their life-cycle.

The total accumulation of nutrients on the other hand is a function of total dry matter production. As November sowings produced maximum total dry matter, the nutriet uptake was also higher in them. The uptake decreased with delay in sowing from November to January. The shorter life period of late sown crops in which they accumulated less dry-matter, is main reason for less nutrient accumulation in later sown crops.

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Table 1. Influence of date of seeding on drymatter accumulation.

Treatments	Dry matter accumulation [g/m row]		%contribution of different plant parts to total dry matter at maturity		
	Ear emergence	Maturity	Culm	Leaves	Ear
Date of seeding		*1973-74*			
Oct. 16	81.6	276 7	54.4	10.5	35.3
Nov. 1	115 2	324.0	56.9	11 3	32.7
Nov. 17	113.7	297.8	49 5	12.6	38.0
Dec. 3	121.5	275.4	51.5	13.6	34.9
Dec. 19	111.9	183.3	41.2	14.8	44.1
Jan, 4	137.5	159.7	40.5	18.2	41.3
Jan. 20	105.4	113.2	38.6	26.2	35.3
CD 5%	6.0	1.9	–	–	–
Varieties					
Raj 911	99 6	220.1	47.4	16.8	35.8
MD 4519	125 1	245.6	47.3	13.8	38.9
CD 5%	5.4	2.4	–	–	–
Date of seeding		*1974-75*			
Oct. 16	95.1	398.0	31.2	9 4	59.5
Nov. 1	23 4	364.4	29.5	12.6	57.9
Nov. 17	101.7	246 9	25.9	15.3	58,8
Dec. 3	86.0	285,5	26.6	18,3	55.2
Dec. 19	128.7	206 9	24.5	19.0	56,6
Jan. 4	119.7	192.7	26.9	16.1	57.1
Jan. 20	116.5	127.4	30.8	13.4	55,9
CD 5%	5.5	25.8	–	–	–
Varieties					
Raj 911	100·0	243.5	29.4	16.4	54.2
MD 4519	107,7	276 9	26.4	13.2	60.3
CD 5%	4.2	21.2	–	–	–

Table 2. Influence of date of seeding on developmental phases and plant height.

Treatment	Days to different developmental phases						plant height (cm)	
	Ear emergence		Maturity		Ear emergence to Maturity			
	1973-74	1974-75	1973-74		1973-74	1974-75	1973-74	1974-75
Date of seeding								
Oct. 16	86	117	162	165	76	48	70.1	64 0
Nov. 1	100	110	142	151	42	41	66 3	68 8
Nov. 17	103	101	137	140	34	39	65 5	67.1
Dec. 3	95	96	127	128	32	32	51.7	64 7
Dec. 19	88	85	117	113	29	28	52.2	53.5
Jan. 4	77	81	106	107	29	26	49.9	53 8
Jan. 20	65	70	98	97	33	27	47 8	55 6
CD 5%	1.6	2.2	1.7	2.2	1.7	2.9	3.1	3 2
Varieties								
Raj 911	92	98	128	130	36	32	61.7	64.8
HD 4615	85	90	126	127	41	37	56.4	67 6
CD 5%	3.5	4.0	1.1	1.8	1.3	2.5	1.9	1.4

TABLE 3 Crop productivity as influenced by date of seeding

Treatment	Total Dry matter yield (q/ha)		Grain Yield (q/ha		Harvest Index	
	1973-74	1974-75	1973-1974	1974-75	1973-74	1974-75
Date of seeding						
Oct. 16	115.7	115.3	43 8	44.9	37.9	38.9
Nov. 1	143.1	130.2	52 0	48.8	36.0	37.5
Nov. 17	121.9	126.2	46.3	48.1	38.0	38.1
Dec. 3	94.6	114 9	35.2	40.7	37.2	35 4
Dec. 19	90 5	92.2	27.3	31.4	30.2	34.1
Jan. 4	65.2	86.6	22.5	27.7	34.5	31 9
Jan. 20	60.9	62.7	25.2	18.8	41.3	30 0
CD 5%	11.4	10.8	4.5	5.0	4.2	5.1
Varieties						
Raj 911	93.3	100.2	30.5	33.9	32.7	33.8
HD 45	104.5	108.0	41.6	40 5	39.9	37.5
CD 5%.	4.7	4.3	3.1	2 3	3.6	3.9

TABLE 4 Relationship of grain yield and its attributes in durum wheat varieties

Yield attributes	Correlation Coefficient			
	Raj 1911		HD 4519	
	1673-74	1974-75	1973-74	1974-75
1000-grain weight	0.816*	0.781*	0,719*	0.8s3*
Grain wt./spike	0,697*	0.134	0.8s9*	0 719*
No grains/Spike	0.280	0.264	0.570*	0.530*
Spike length	0.486*	0.590*	0.219	0.601*
No. spikes/unit area	0.245	0.310	0.447*	0.408*

*Significant at p=0.05

TABLE 5 NPK-Content and uptake in durum wheat varieties as influenced by date of seeding

Treatments	Concentration (%)		
	N	P	K
	whole plant	whole plant	whole plant
Date of seeding		*1973-74*	
Oct. 16	0.8	0 14	1.5
Nov. 1	0.9	0.19	1.6
Nov. 17	0 9	0.16	1.6
Dec 3	1.1	0 16	1.6
Dec. 19	1.1	0.16	1.9
Jan. 4	1.2	0.16	1.7
Jan. 20	1.3	0.19	1.9
CD 5%	0.04	0.00	0.05
Varieties			
Raj 911	1.0	0.18	1.7
HD 4519	1.1	0 18	1.7
CD 5%	0.04	NS	NS
Date of Seeding	1974-75		
Oct 16	0 9	0.13	1.4
Nov 1	1.0	0 14	1.5
Nov. 17	1.0	0.14	1.5
Dec. 3	1.0	0.16	1 6
Dec. 19	1.0	0 16	1.7
Jan. 4	1.1	0.19	1.7
Jan. 20	1.2	0.18	1 8
CD 5%	0.05	0 01	0.05
Varieties			
Raj 911	1.0	0.15	1.6
HD 4519	1.0	0.16	1.6
CD 5%	NS	0.007	0 05

Treatments	Uptake (kg/ha)		
	N	P	K
Date of seeding	1973 - 74		
Octo 16	112	16.95	175
Nov 1	137	25 24	238
Nov. 17	120	17.90	195
Dec. 3	106	15.08	155
Dec 19	87	12.46	154
Jan. 4	76	10.52	114
Jan. 20	78	11.90	116
C D5%	11	2.19	19
Varieties			
Raj 911	90	15.62	155
HD 4518	115	16.06	173
C D 5%	10	NS	9
Date of seeding	1974 - 75		
Oct. 16	112	15.92	170
Nov. 1	129	18.12	201
Nov. 17	128	20 52	200
Dec. 3	125	18.86	191
Dec. 19	94	15.29	158
Jan. 4	97	15 93	153
Jan. 20	82	11.35	114
C D 5%	4	1.72	6
Varieties			
Raj 911	102	15.22	167
HD 4519	117	17.91	173
C D 5%	6	1.00	3