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Phenophasic study of rice varieties under different crop growing environment

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Abstract
A field experiment was conducted during kharif season of 2018 entitled "Phenophasic study of rice varieties under different crop growing environment" at N.D. University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.). The experiment consisted of nine treatment combinations which comprised of three crop growing environment *viz.* July 15th, July 25th and August 04th and three varieties viz., NDR-97, NDR-2064 and BPT-5204. Results reveal that higher days taken to all phenophases from tillering to physiological maturity were recorded in crop growing environment of July 15th followed by July 25th. Among the varieties, BPT-5204 recorded higher days taken to physiological maturity followed by NDR-2064. Variety NDR-2064 followed by BPT-5204 were found suitable for higher growth, yield attributes and yield of rice. Crop growing environment of 15th July and variety NDR-2064 possess congenial weather and harvested maximum growth, yield attributes and yield of rice.

Keywords: Phenophasic duration, yield attributes, yield, growing environment, rice

Introduction
Rice is one of the most important cereal crop belong to the family *Poaceae.* It is the staple food for half of the world's population Temperature regimes greatly influenced not only the growth duration, but also the growth pattern and the productivity of rice crops. Extreme temperatures whether low or high cause injury to the rice plant. In tropical regions, high temperatures are a constraint to rice production. The most damaging effect is on grain sterility, just 1 or 2 hours of high temperature at anthesis (about 9 days before heading and at heading) result in a large percentage of grain sterility. Studies on rice productivity under global warming also suggest that the productivity of rice and other tropical crops will decrease as global temperature increases. Mohandrass *et al.* (1995) [3]**.** Such warming will thus reduce rice growth. In addition, higher temperatures will cause spikelet sterility owing to heat injury during panicle emergence. In temperate regions, increased air temperatures should hasten rice development, there by shortening the time from transplanting (or direct seeding) to harvesting and reducing the total time for photosynthesis yield development (Nguyen, 1994) [4]. Rice is very sensitive to higher temperature during reproductive stage especially flowering and anthesis. The elevated temperature at the time of flowering and maturity determines the yield per seed of the genotypes. Under high temperature stress, the response of genotypes depended on developmental stage, but highest sensitivity was recorded at reproductive stage. The time of sowing, days to flowering (duration group), heat escape (early morning flowering) and inbuilt tolerance were the crucial factors in determining the performance of genotypes to varying temperature. Hence, it is necessary to select genotypes by keeping in view the above factors for different temperature stress within and across the environment (Raju *et al.* 2013) [5]. Hence, present investigation was under taken.

Materials and Methods
A field experiments was conducted at N. D. University of Agriculture & Technology, Kumarganj, Ayodhya (U.P.) during *kharif* season of 2018 which lies at latitude 26° 47'North longitude 82° 12' East and altitude of 113 meter from mean sea level in the Indo-genetic alluvium of Eastern Uttar Pradesh. The experiment was carried out in Randomized Block Design (Factorial), and replicated four times. The experiment comprised of three crop growing environment i.e. 15th July, 25th July and 04th August with three varieties i.e. NDR-97, NDR-2064 and BPT-5204. Fertilizers were applied @120:60:60 N: P_2O_5: K_2O kg/ha 1/3rd of

Nitrogen and total phosphorous and potash were applied as basal application just before puddling and incorporated in the top 15 cm soil. Remaining dose of nitrogen was applied as top dressing in two equal doses at tillering and at panicle initiation stages. The soil of the experimental field was silty loam in texture and medium in fertility having pH 8.5. Total numbers of days taken from transplanting to different phenophases of rice crop were recorded as to know the effect of various treatments on the phenophasic duration of crop.

The recovery of grain in total dry matter was considered as harvest index which was expressed in percentage and calculated by using following formula;

$$HI\% = \frac{\text{Economic yield(Grain Yield)}}{\text{Biological yield(Grain Yield+Straw Yield)}} \times 100$$

Results and Discussion

Days taken to different phenophases of rice

Different crop growing environment and rice varieties influenced markedly to days taken to phenophases of rice (Table-1). Maximum days (116 days) taken to maturity were recorded when crop was transplanted on July 15th followed by July 25th (113 days) due to occurrence of more thermal units. The minimum days (108 days) taken to maturity was recorded in crop growing environment of August 04th due to occurrence of less thermal unit caused as the result of suboptimal growth parameters.

Among the varieties, maximum days taken to maturity were recorded with BPT-5204 (132 days) followed by NDR-2064 (112 days) and minimum days in NDR-97 (92 days) of rice variety. Similar results were reported by Jasti *et al.* (2017) [2].

Yield Attributes and yield:

Higher No. of effective tillers/m^2, No. of filled grains/panicle and length of panicles were significantly affected due to growing environment and varieties (Table-2). Significantly higher yield attributes was recorded in July 15th mainly due to better source of assimilates which had direct bearing on translocation of photosynthates from source to sink. Among the varieties, higher values of yield attributes were recorded in NDR-2064 which was significant over BPT-5204 and NDR-97 varieties of rice. Different crop growing environment had influenced significantly to the grain yield (Table-2). Significantly higher grain yield was recorded when crop was transplanted on July 15th, which was significantly superior over July 25th and August 04th mainly due to better growth and yield attributes. The lowest grain yield was recorded when crop was transplanted on August 04th. This might be due to poor translocation of photosynthates from source to sink in delayed transplanting. Among the varieties, higher grain yield (48.2 q/ha) was recorded with NDR-2064 variety which was at par with BPT-5204 (47.7 q/ha) mainly due to better growth and yield attributes. Higher straw yield (55.2 q/ha) was recorded with crop growing environment of July 15th which was at par with July 25th. This was mainly due to higher biomass production as the result of better plants and LAI. Among the varieties, higher straw yield (58.7 q/ha) was recorded with NDR-2064 which was significant over rest both of the varieties. Similar results were reported by Chand *et al.* (2016) [1].

Conclusions

Conclusively, different crop growing environment and rice varieties influenced to the days taken to phenophases. Maximum days (116 days) taken to maturity were recorded when crop was transplanted on July 15th. Among the varieties, maximum days taken to maturity were recorded with BPT-5204 (132 days). Different crop growing environment had influenced significantly to the yield attributes and yield. Significantly higher yield attributes and yield were recorded when crop was transplanted on July 15th which was significantly superior over July 25th. Higher yield attributes and yield were recorded with NDR-2064 variety, which was at par with BPT-5204.

Table 1: Days taken to different phenophases as affected by different treatment of rice.

Treatments	Days taken to phenophases					
	Tillering	Panicle Initiation	Days to 50% Flowering	Milking	Dough stage	Physiological Maturity
Crop growing environments						
15th July	46	70	83	97	107	116
25th July	45	69	81	94	104	113
04th August	40	65	76	88	98	108
Varieties						
NDR-97	40	60	68	78	85	92
NDR-2064	43	65	76	90	103	112
BPT-5204	50	78	97	111	121	132

Table 2: Yield and yield contributing characters as affected by different crop growing environment of rice varieties.

Treatments	Yield and yield contributing characters						
	No. of effective Tillers/m^2	No. of filled grains/panicle	Length of panicle (cm)	Test weight (g)	Grain yield (q/ha)	Straw Yield (q/ha)	Harvest Index (%)
Crop growing environments							
15th July	347.5	101.3	22.1	22.1	48.2	55.2	42.1
25th July	329.9	95.5	21.1	21.8	40.1	53.9	41.5
04th August	318.4	85.6	19.4	21.1	34.0	50.5	40.2
SEm±	5.87	1.66	0.37	0.38	0.66	0.94	0.73
CD (5%)	17.14	4.84	1.07	NS	1.93	2.74	NS
Varieties							
NDR-97	310.8	80.5	18.2	19.6	32.4	46.3	40.8
NDR-2064	352.8	107.7	23.3	23.2	48.2	58.7	41.8
BPT-5204	332.3	94.2	21.1	22.2	47.7	54.6	41.2
SEm±	5.87	1.66	0.37	0.38	0.66	0.94	0.73
CD (5%)	17.14	4.84	1.07	1.11	1.93	2.74	NS

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