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Effect of different date of transplanting on growth and yield of rice (*Oryza sativa* L.) varieties under Indo-gangetic plains of Awadh area

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Abstract
The field experiment entitled "Effect of different date of transplanting on growth and yield of rice (*Oryza sativa* L.) varieties" was conducted at Agronomy Research Farm of Narendra Deva University of Agriculture & Technology, Narendra Nagar (Kumarganj), Faizabad, Uttar Pradesh during *Kharif* season of 2015 with an objective to find out suitable date of transplanting of rice, the treatment consisted of three transplanting date (15 July, 25 July and 5 August) and three varieties (Sarju-52, NDR-359 and Swarna) there were 9 treatment combinations.

The values of growth contributing characters *viz*. plant height (cm), number of tillers, dry matter accumulation, leaf area index and yield attributes like number of panicles m^{-2}, length of panicle (cm), number of panicle^{-1}, grain weight panicle^{-1}, grain and straw yield (q ha^{-1}) were increasing significantly with 15 July date of transplanting followed by 25 July date of transplanting and significantly superior with 5 August date of transplanting. In case of variety the performance the growth characters like plant height (cm), number of tillersm^{-2}, dry matter accumulation (g m^2) leaf area index and yield attributes like number of panicles m^{-2}, length of panicle (cm), number of panicle^{-1}, grain weight panicle^{-1}, grain and straw yield (q ha^{-1}). Swarna recorded higher yield and yield attribute which was at par with NDR-359 and significant over Sarju-52.

Keywords: Transplanting, *Oryza sativa*, indo-gangetic, Awadh area

Introduction
Rice (*Oryza sativa* L.) is one of the most important cereal crops of *kharif* season. Rice is cultivated world-wide over an area of about 160.68 million ha^{-1} with an annual production of about 650.19 million tonnes. In India it is cultivated over an area of about 39.16 million hectares with an annual production of about 85.59 million tonnes and the productivity of 2.20 tonnes ha^{-1}. Uttar Pradesh is an important rice growing state in the country. The area and production of rice in U.P. is about 13.84 million hectare and 14.00 million tonnes respectively with an average production of 2.35 tonnes (Anonymous, 2013) [1-4]. Production of rice rank second among the food grain and half of the world population receiving the highest (26.2%) calories intake from it in the developing countries of their dietary protein (FAO, 2009) [6]. Rice is an excellent source of carbohydrate and to a certain extent it provides protein to regular human diet. So it is used as staple food crop by about half of the world population and eaten as cooked rice and also used for various preparations inhabiting in the humid tropics and subtropics. Further, rice has commercial and industrial importance also beside grains. Rice straw and rice hulls are used as fodder, mulching, packing and as insulation material etc.

Globally rice is grown on 153 mha (FAO, 2006) [5]. Though its production and consumption is concentrated in Asia, where more than 90% of rice is consumed. India produced 103.41 million tones during 2011-12 from 44.07 million hectares with average productivity of 2270.75 kg/ha. Dry matter accumulation in leaves decreased in test cultivars (PR-106, PR-109 and Basmati-370) with later transplanting dates. Delayed transplanting reduced seedling dry matter in PR-106 and PR-109, but an increase was observed in Basmati-370 with least accumulation of dry matter in leaves.

Different varieties respond variably under different date of transplanting. In view of above facts, the present investigation entitled, "Effect of different date of transplanting on growth and yield of rice (*Oryza sativa* L.) Varieties" was conducted during kharif 2015 with the

Material and Methods

The experiment was performed at Agronomy Research Farm of Narendra Deva University of Agriculture & Technology, Narendra Nagar (Kumarganj), Faizabad, Uttar Pradesh during *Kharif* season of 2015 with an objective to find out suitable date of transplanting of rice, the treatment consisted of three transplanting date (15 July, 25 July and 5 August) and three varieties (Sarju-52, NDR-359 and Swarna) there were 9 treatment combinations. The experimental was conducted in Split plot design (SPD) and replicated four times. Geographically, Faizabad (Kumarganj) falls in subtropical climate under sub humid, of Indo-gangetic alluvial plains having alluvial calcareous soil. The research farm is situated at 26^0.47' North latitude, $82^0$12' East longitude with an altitude of 113 meters above mean sea level. The Experimental field was slightly alkaline in reaction (7.9 pH), low in organic carbon (0.42%) and low in available nitrogen (160 kg ha^{-1}), phosphorus (16.5 kg ha^{-1}) and medium in potassium (260 kg ha^{-1}).

Results and Discussion

1 Effect of different date of transplanting

Growth characters

Plant height was significantly influenced by different date of transplanting at all the stages of crop growth. Maximum plant height was recorded with 15 July date of transplanting which was at par with the 25 July date of transplanting and significantly superior to rest of the treatments at all the stages of crop growth. 15 July recorded significantly taller plant than the 25 July of transplanting.

Dry matter accumulation were recorded higher in 15 July date of transplanting followed by 25 July. Dry matter accumulation is associated with increased in assimilation of food material through photosynthesis on account of vigorous root and shoot growth. The higher dry matter production in 15 July date of transplanting at each growth stage and lower dry matter production in 5 August date of transplanting.

2 Yield and yield attributing character

Number of panicle m^{-2}, length of panicle, number of grains $panicle^{-1}$ and test weight was significantly influenced by different date of transplanting. Significantly higher values of yield attributes were recorded under 15 July date of transplanting. Yield attributing characters are the function of growth and development that develop during vegetative phase of the plant. Due to better partitioning of photosynthates from source to sink as a result of better growth owing to favorable growing conditions might have resulted in better development and higher value of yield attributes. The results are in conformity with the finding with Kumar *et al.* (2013) [8].

Grain yield and straw yield of rice was influenced significantly by different date of transplanting. The crop established under different date of transplanting 15 July date of transplanting resulted in significantly higher grain yield followed by 25 July and 5 August date of transplanting and lowest grain yield under 5 August was obtained. Yield is functions of complex inter relationship of growth in vegetative phase and yield attributes, as well. Higher yield under 15 July date of transplanting was due to better crop growth and development resulting in to higher value of yield attributes which had direct bearing on the grain yield. Khan *et al.* (1990) observed the similar findings. Higher number of panicle per unit area, panicle size and filled grains percentage in case of 15 July date of transplanting as compared to 25 July date of transplanting and 5 August date of transplanting crop establishment might be responsible for superiority of this treatment over other in respect of grain yield.

Straw yield of rice were also highest where rice crop was transplanted by 25 July date of transplanting followed by 15 July date of transplanting and 5 August date of transplanting. Higher number of tillers/hill with moderate plant height and better performance of yield attributing ultimately led the increase the biomass in the 15 July date of transplanting of rice. The lowest yield was recorded 5 august date of transplanting due to lesser effective tiller/hill and increased inter and intra plant competition for available growth resources.

Harvest index is the function of grain yield to the total biological yield (grain+straw). Harvest index was also influenced significantly due to different date of transplanting. The higher harvest index was recorded with 15 July date of transplanting.

Effect of varieties

Growth characters

Plant height was influenced by varieties was at all the stages of crops of the crop. Significantly higher plant height was recorded where NDR-359 was given & it remained at par with sarju-52. Plant height increased mainly due to adequate nutrient supply to the plant which resulted into rapid growth by good establishment of root and various metabolic processes and ultimately performed better mobilization of synthesized carbohydrates in to amino acid and protein which stimulated the rapid cell division and cell elongation. Finally, it resulted in to growth of plant faster as compared to other treatments tested during the course of investigation. The lowest plant height was recorded with Swarna at all growth stages.

Varieties had significantly effect on the dry matter accumulation at all the growth stages 30, 60, 90 and harvest stages, Higher dry matter accumulation was recorded under Swarna which was at par with treatment NDR-359 as compared to rest of treatment. This might be due to the long duration varieties provide proper time for increased plant height, produced more number of shoot and leaf area index. Lower dry matter accumulation was recorded under treatment sarju-52 at all growth stages.

The yield attributes *viz*; number of effective tiller/hill, length of panicle, and number of grains/panicle were influenced significantly due to varieties. However, significantly higher value of these yield attributes were recorded with the Swarna which was at par with NDR-359.This might be attributed due to the long duration varieties which found adequate time for favored vegetative growth and development and ultimately increased plant height, produced more number of tiller, more number of panicles and more dry matter production. Cumulative effect of all these characters led to higher yield attributes. The lower value were unable to obtain under Sarju-52 because plant were unable to obtain proper time for sufficient vegetative growth and yield attributes.

Grain and straw yield were affected significantly due to various varieties. Significantly higher grain and straw yield of rice were obtained with the Swarna which was at par with NDR-359 as compared to rest of treatments. This might be due to increased yield attributes *viz*-number of effective tillers, length of panicle, number of grains/panicle, weight of grain/panicle which resulted in higher yield. The long duration and suitable varieties which contributed to increased dry matter production. Lowest grain and straw yield were recorded with Sarju-52.

Table 1: Plant height (cm) as affected by different date of transplanting and varieties of rice

Treatment	Plant height (cm)			
	30 DAT	60 DAT	90 DAT	At harvest
Date of transplanting				
15 July	36.6	77.0	110.9	110.4
25 July	35.3	75.3	108.7	108.1
5 August	32.8	68.1	98.2	98.1
S.Em±	0.84	1.69	2.13	2.13
C.D. at 5%	2.91	5.87	7.40	7.37
Varieties				
Sarju-52	34.9	68.4	105.9	105.1
NDR-359	35.2	70.4	105.3	105.0
Swarna	37.9	73.5	113.6	119.5
S.Em±	0.68	1.49	1.75	1.97
C.D. at 5%	2.03	4.45	5.20	5.88

Table 2: Dry matter accumulation (g m^{-2}) of rice as affected by different date of transplanting and varieties

Treatment	Dry matter accumulation (g m^{-2})			
	30 DAT	60 DAT	90 DAT	At harvest
Date of transplanting				
15 July	147.7	501.9	887.8	1009.8
25 July	138.8	466.9	832.3	1040.3
5 August	124.4	425.8	768.1	960.1
S.Em±	3.52	13.42	21.91	30.89
C.D. at 5%	11.11	42.28	69.06	97.33
Varieties				
Sarju-52	127.2	442.7	784.0	980.0
NDR-359	144.9	488.8	885.7	1007.1
Swarna	138.6	463.0	818.4	1023.0
S.Em±	2.75	9.23	16.09	20.93
C.D. at 5%	8.03	26.93	46.97	61.10

Table 3: Yield attributes and yield of rice as affected by different date of transplanting and varieties

Treatment	No. of Effective tillers/m^2	Length of panicle(cm)	No. of grains/panicle	Test weight (g)	Grain yield (q/ha)	Straw yield (q/ha)	Harvest index (%)
Date of transplanting							
15 July	436.5	10.4	167.3	26.6	48.7	72.7	40.1
25 July	410.4	9.8	155.6	25.2	46.1	69.2	40.0
5 August	368.0	9.5	141.9	24.9	40.4	63.8	39.9
S.Em±	12.08	0.23	4.47	0.04	1.35	1.75	
C.D. at 5%	38.08	0.72	14.09	NS	4.28	5.53	
Varieties							
Sarju-52	376.36	7.25	147.6	24.47	43.7	64.28	39.98
NDR-359	409.90	9.93	154.3	25.17	44.9	67.02	39.99
Swarna	418.74	10.63	163.9	26.10	48.5	74.45	40.01
S.Em±	8.45	0.19	3.07	0.09	0.90	1.47	
C.D. at 5%	24.68	0.56	8.98	NS	2.64	4.31	

Conclusions

On the basis of summarized results it may be concluded that the 15th July date of transplanting was found better for growth and yield of all the varieties of rice testers. Whereas, variety Swarna was found suitable for rice cultivation as to harvest the higher yield. However, Interaction between date of transplanting and varieties was found non-significant.

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