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DELAYED TRANSPLANTING CAUSES THE YIELD DIFFERENCE BETWEEN EXPERIMENTAL PLOT AND FARMER'S FIELD IN RICE

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ABSTRACT: *An experiment was conducted at Agriculture Botany Division Farm, Khumaltar, Lalitpur, Nepal to find out causes of yield difference between experimental plot and farmer's field in 2013 and 2014. Randomised complete block design with three replication was used to compare twelve rice genotypes with Khumal-4 as a standard check. One set of genotypes were transplanted in the normal season i.e. last week of June and the other set was transplanted two weeks delayed to meet farmer's transplanting time. Different rice parameters like grain yield, plant height, panicle length, days to heading and maturity were found significant ($p<0.05$). Grain yield and total biomass of normal transplanted rice were found higher than delayed transplanted rice in both year. The reason could be that too early and too late transplanting could not fulfill the required temperature and photoperiod for rice crop. Late transplant are severe to cold and effect plant growth and yield. Thus the yield difference between experimental plot and farmer's field can be minimised by transplanting rice in appropriate time with recommended package of practices.*

KEYWORDS: Delayed Transplanting, Aged Seedlings, Yield Difference, Potential Yield, Farmer's Field

INTRODUCTION

There is a high yield difference between experimental plot and farmer's field in developing countries like Nepal (NARC, 1997). Though farmers grow rice in well managed way, found difficulty to get its potential yield. Many agricultural scientists and policy makers have reported the yield gap between experimental plot and farmer's field, and some of which are farmer's poor field management, less use of fertilizers, lack of high yielding fertilizer responsive variety, unavaibility of irrigation facility in time and lack of trained farmers etc (NARC, 1997). Earlier scientists have reported that late transplanting cause yield reduction and reduce total biomass of the crop (Santhi et al., 1998).

Yield is the end result of interaction between genetic constitutions of a plant and environment under which it grows. Among environmental factors, climate plays an important role in getting high yield. The highest yield can be harvested with earliest planting (Kumar, 2001). Nielsen and Thomison (2003) also reported that delayed planting of corns shortens the available growing seasons. The reason could be that too early and too late transplanting could not fulfill the required temperature and photoperiod for rice crop. Late transplant are severe to cold and effect plant growth and yield (Bashir et al., 2010). Akram et al. (2007) reported that yield and yield parameters like number of tillers, grains per panicle, plant height, 1000 grain weight and sterility of different rice varieties were significantly affected by transplanting dates. Similarly, Gangwar and Sharma (1997) also observed more number of panicles in early transplanting than in late transplanting. This was due to the fact that rice genotypes planted earlier had longer period for their vegetative growth compared to those sown later. But Nazir (1994) reported that

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earlier transplanting in rice causes lower number of grains per panicle due to grain sterility because of high temperature at the time of grain maturation. Transplanting at its optimum time reduces grain sterility. The overall results of the present investigations lead us to the conclusion that there is a significant effect of transplanting dates on the yield, yield components and days taken to 100% flowering of rice genotypes even though all input materials are supplied in time (Safdar et al., 2008). Thus transplantation of high yielding varieties of rice at the appropriate time is the most important factor for obtaining high yield of rice. Experimental plots are well facilitated but most farmer's field depends on rainfall and availability of labour for transplanting. Thus farmer's can not transplant rice in normal time and they transplant a few weeks delayed than rice transplanted in experimental plot. Hence the main objective of this experiment was to find out the reasons behind the yield difference between experimental plot and farmer's field though farmers supply all inputs materials in time for rice production, but they get lower yield compared to experimental plot.

MATERIAL AND METHODS

This experiment was conducted in Agriculture Botany Division Farm, Khumaltar, Lalitpur, Nepal at an altitude of 1368 m from mean sea level and latitude of 27^0 $40^'$ N 85^0 $20^'$ E. Randomised complete block design was used to perform this experiment with three replication. Two sites were chosen for normal and delayed transplanting. Irrigated lowland was chosen for normal transplanting whereas rainfed upland was used for delayed transplanting. A total of twelve rice genotypes were selected for coordinated varietal trial (CVT) from initial evaluation trial (IET) along with Khumal-4 as a popular standard check. Six rice genotypes viz. IR 84899-B, NR 10676-B-5-3, NR 11050-B-B-B-B-17, YR25696-B-196-3-3, NR 11011-B-B-B-B-29 and 08FAN10 were common in both year 2013 and 2014 trial. Soil test was done before transplanting and the soil of the experimental plot was silty-clay loam with pH 6.5 to 6.7. Recommended dose of fertilizers @80:30:30 kg/ha NPK were applied. Half dose of nitrogen and full dose of phosphorus and potassium was applied as basal. 1/4th part of nitrogen was applied at 30 days i.e. at tillering stage after 1st weeding and the remaining 1/4th at booting stage after 2nd manual weeding. A total of 4m x 3m net plot area with a spacing of 20cm x 15cm was used for transplanting. One seedling per hill was transplanted in both normal and delayed transplanting. Rice normal transplanting was done in normal season of the year i.e. last week of June when seedlings were 25-28 days old but delayed transplanting was done at later time i.e. 1st week of July when seedlings became 38-40 days old to adjust farmers transplanting time in both year 2013 and 2014. Rice different parameters such as days to 80% heading, days to 80% maturity, panicle length, plant height, fertile grain number per panicle and grain yield per hectare were taken following International Rice Research Institute (IRRI) standard protocol for analysis and intrepretation of data. Statistical analysis were done by using MSTAT and GenStat program.

RESULTS AND DISCUSSION

Days to Heading and Maturity

The average days to 80% rice heading was 113 and 121 days for normal and delayed transplanting. Similarly, days to 80% maturity was 151 and 159 days for normal and delayed

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transplanting in 2013 respectively (table 1, figure 1). The days to heading and maturity are stastistically significant for both normal and delayed transplanting ($p<0.05$). In the same way, average days to heading was 106 and 127 days for normal and delayed transplanting. And days to maturity was 143 and 166 days for both normal and delayed transplanting respectively in 2014 (table 2, figure 2). Intrepretation of above data shows that days to heading and maturity in delayed transplanting was longer than normal transplanting. This result is similar to the findings of Nahar et al. (2009) and Shah (2001) who reported delayed transplanting cause delay heading and maturity which might be due to low solar radiation during crop vgetative stage.

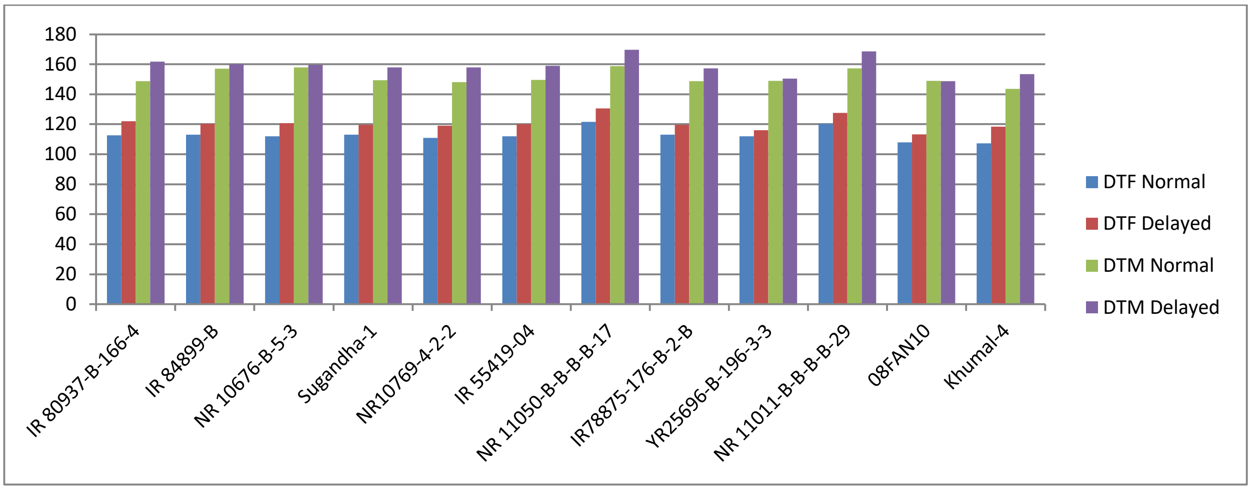

Figure 1. Days to 80% heading and days to 80% maturity of CVT rice genotypes in normal and delayed transplanting 2013.

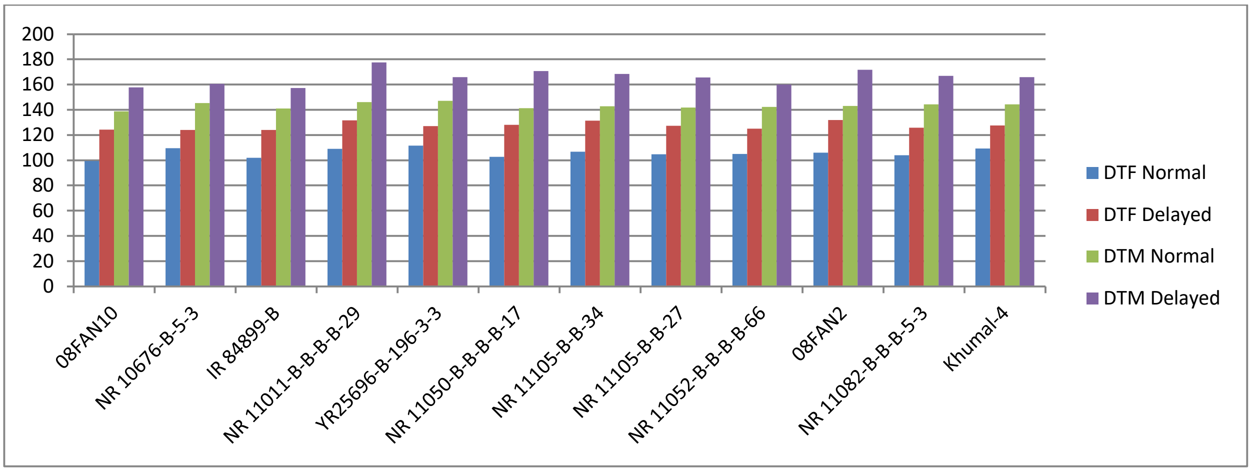

Figure 2. Days to 80% heading and days to 80% maturity of CVT rice genotypes in normal and delayed transplanting in 2014.

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Plant Height

Statistically significant plant heights were found for both normal (134 cm) and delayed (115 cm) transplanting in 2013 (table 1) ($p<0.05$). Similarly, statistically different plant height was found for normal (137 cm) and delayed (101 cm) transplanting in 2014 (table 2). The decrease of plant height in the both years of delayed transplanting might be due to improper development of roots and short photoperiod duration. This result is similar to the findings of Vandana et al. (1994) who reported that dry matter accumulation in leaves decreased with test cultivar with later transplanting dates.

Table 1. Comparision of different traits of CVT rice genotypes in normal and delayed transplanting of rice 2013.

	DTF		DTM		PHt		Panln		FGNo		Gyld	
CVT 2013	Normal	Delayed	Normal	Delayed	Normal	Delayed	Normal	Delayed	Normal	Delayed	Normal	Delayed
IR 80937-B-166-4	113	122	149	162	122	105.00	23.93	23.33	109	117	6710.00	6743.00
IR 84899-B	113	120	157	160	119	111.00	25.13	25.67	98	134	7647.33	6067.67
NR 10676-B-5-3	112	121	158	160	155	118.00	29.00	27.00	113	154	6239.67	6181.67
Sugandha-1	113	120	149	158	138	109.67	24.40	24.33	82	122	6021.33	5396.67
NR10769-4-2-2	111	119	148	158	147	124.33	28.47	28.33	143	138	8102.67	5463.33
IR 55419-04	112	120	150	159	110	92.00	23.87	23.67	96	89	6704.33	5007.67
NR 11050-B-B-B-B-17	122	131	159	170	142	123.33	28.80	27.67	110	136	6221.00	5587.33
IR78875-176-B-2-B	113	120	149	157	118	109.33	26.27	25.33	95	110	7351.33	5898.67
YR25696-B-196-3-3	112	116	149	150	152	132.00	26.53	27.67	163	192	6773.67	6380.67
NR 11011-B-B-B-B-29	120	128	157	169	158	136.33	27.00	24.67	131	136	7081.67	5718.67
08FAN10	108	113	149	149	100	101.67	25.60	24.33	134	96	7252.67	5411.33
Khumal-4	107	118	144	153	146	119.00	27.00	25.33	160	112	6354.00	6085.67
Mean	113	121	151	159	134	115.14	26.33	25.61	120	128	6871.64	5828.53
CV %	0.65	0.89	0.45	1	2.78	11.62	2.53	7.01	16.46	14.9	10.02	12.58
p value	0.001	0.001	0.001	0.001	0.001	0.0207	0.001	0.0258	0.0004	0.0001	0.03	0.2704
LSD at 5 %	1.25	2.10	1.14	2.69	6.30	21.88	1.13	2.95	33.3	33.01	1165	1270.3

(DTF=Days to Flowering; DTM=Days to Maturity; PHt=Plant Height (cm); Panln=Panicle Length (cm); FGNo=Fertile Grain Number; Gyld=Grain Yield/ha)

Panicle Length

Significant panicle length was obtained from normal (26 cm) and delayed (25 cm) translpanting in 2013 and 2014 at 0.05 probability level (table 1 and 2). Reduction in panicle length in delayed transplanting from the normal one may be due to lack of full photosynthesis during its growing period, inability of roots to absorb minerals from soil. This result reveals the findings of Hussain et al. (2005) and Shah (2001) who reported that maximum number of panicle was produced by line transplanted method in early transplanting. This might be due to adaptation with climate, well adopted root system and well adopted leaf structure and canopy having optimum light absorption, nutrients uptake and synthesis of more carbohydrates.

Number of Kernel per Panicle

Fertile grain number per plant is a direct attributes of yield. Significant difference was found in number of kernel per panicle of normal (120) and delayed (128) transplanting in 2013 ($p<0.05$) (table 1). Similarly, statistically non significant data were occured between normal (144) and delayed (91) transplanting in 2014 (table 2). These results resembles to the findings of Akram et al. (2007) and Kameswara and Jackson (1997) who reported that number of kernels per panicle were significantly affected as sowing date is delayed. Awan et al. (2011) also reported that reasons for low yield and less grain number are use of imbalance inputs at improper time, transplanting of aged rice nursery and imbalanced use of fertilizer etc. However these results are contrary to that of Habibullah et al. (2007) who reported that sowing date had no significant effect on number of grains per panicle.

Table 2. Comparision of different traits of CVT rice genotypes in normal and delayed transplanting of rice 2014.

Genotypes	DTF		DTM		PHt		Panln		FGNo		Gyld	
	Normal	Delayed	Normal	Delayed	Normal	Delayed	Normal	Delayed	Normal	Delayed	Normal	Delayed
08FAN10	99	124	139	158	116	91	25.67	23.07	124	91	6768.45	3013.54
NR 10676-B-5-3	110	124	145	161	141	104	27.47	24.80	158	93	6720.98	3030.09
IR 84899-B	102	124	141	157	115	91	25.47	24.07	120	98	5052.09	2400.45
NR 11011-B-B-B-B-29	109	132	146	178	146	104	26.87	25.73	138	87	7336.35	2182.00
YR25696-B-196-3-3	112	127	147	166	156	114	26.87	26.13	153	126	6256.67	2783.92
NR 11050-B-B-B-B-17	103	128	141	171	139	107	25.93	26.13	137	91	7294.24	2320.36
NR 11105-B-B-34	107	131	143	168	135	96	26.73	25.87	158	61	5738.70	1861.22
NR 11105-B-B-27	105	127	142	166	132	98	25.53	24.93	153	128	7492.66	2726.89
NR 11052-B-B-B-B-66	105	125	142	160	154	109	28.53	27.13	169	65	7154.99	1847.15
08FAN2	106	132	143	172	120	87	25.60	22.60	127	73	6110.90	2028.87
NR 11082-B-B-B-5-3	104	126	144	167	148	108	27.73	25.60	149	87	6982.07	2887.10
Khumal-4	109	128	144	166	147	109	29.20	27.53	137	86	7359.95	2283.79

Mean	106	127	143	166	137	101	26.8	25.3	144	91	6689.00	2447.11
CV %	7.17	4.85	3.37	5.88	13.46	16.16	5.89	8.92	24.86	32.61	19.77	36.32
p value	ns	ns	ns	0.366	0.1279	ns	0.1041	0.2818	ns	0.2298	ns	0.1149
LSD at 5%	12.25	9.993	7.809	15.73	29.97	27.34	2.815	3.664	58.34	52.88	2139.1	1582.2

(DTF=Days to Flowering; DTM=Days to Maturity; PHt=Plant Height (cm); Panln=Panicle Length (cm); FGNo=Fertile Grain Number; Gyld=Grain Yield/ha; ns=non significant)

Grain Yield

Grain yield is the main component of a crop. Normal transplanted rice (6871 kg/ha) had higher average grain yield than late transplanted rice (5828 kg/ha) in 2013 ($p<0.05$) (table 1 and figure 3). Similarly, average grain yield was also found higher in normal transplanted rice (6689 kg/ha) than late transplanted rice (2447 kg/ha) in 2014 ($p<0.05$) (table 2 and figure 4). These results show that normal transplanted rice has far higher grain yield than late transplanted rice (figure 5). Thus these results are similar to the findings of Hwang et al. (1998) who reported that paddy yields deteriorated as planting date was delayed. Shah (2005) also reported that June 15 seeding recorded significantly the highest paddy yield and decreased with the delay in planting time. In the same way, Iqbal et al. (2008) reported that the highest yield was obtained when the rice crop was sown earlier in the season. Similarly, according to Baloch et al.(2006) among planting dates, June 20th planted crop gave highest paddy yield. Somato et al. (1961) concluded that early transplanting of seedlings resulted in higher yield of grain than late transplanting. This concept is further supported by Khan and Baloch (1970) and Pirzada et al (1962) who revealed that sowing of nursery in the month of April and transplanting in June produced the highest yields which reveals the results of Bali and Uppal (1995) who concluded that rice crop transplanted on 10th July gave 9.4 to 17.9 % higher grain yield than 30th July transplanting due to higher root density, NPK uptake and head rice recovery. Khakwani et al. (2006) also suggested that highest paddy yields are obtained in early transplanting. The reason could be that this might be due genotype genetic superiority, appropriate temperature for growth and development, nutrients absorption, proper root system of the genotype and proper time of transplanting which leads to provide optimum duration for seed filling.

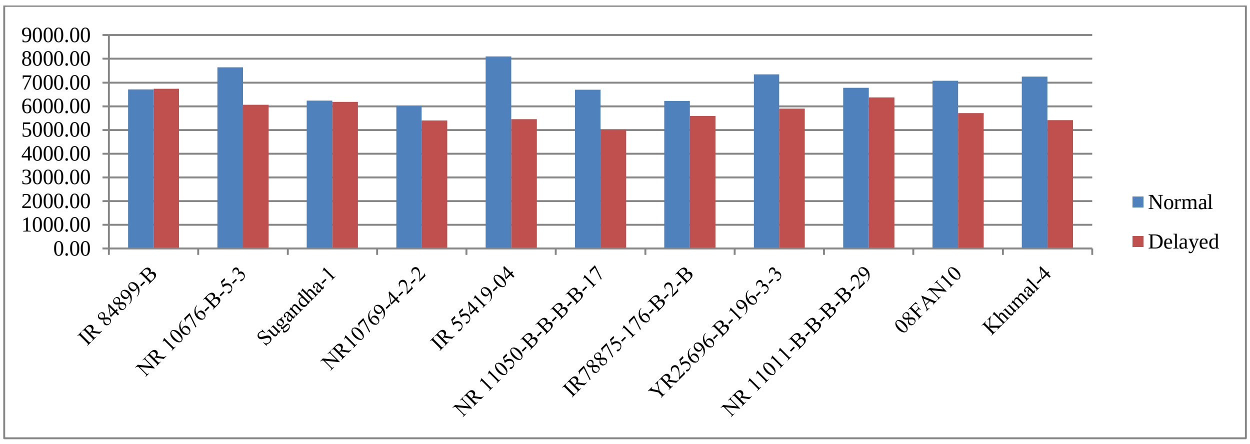

Figure 3. Grain yield of CVT rice genotypes under normal and delayed transplanting 2013.

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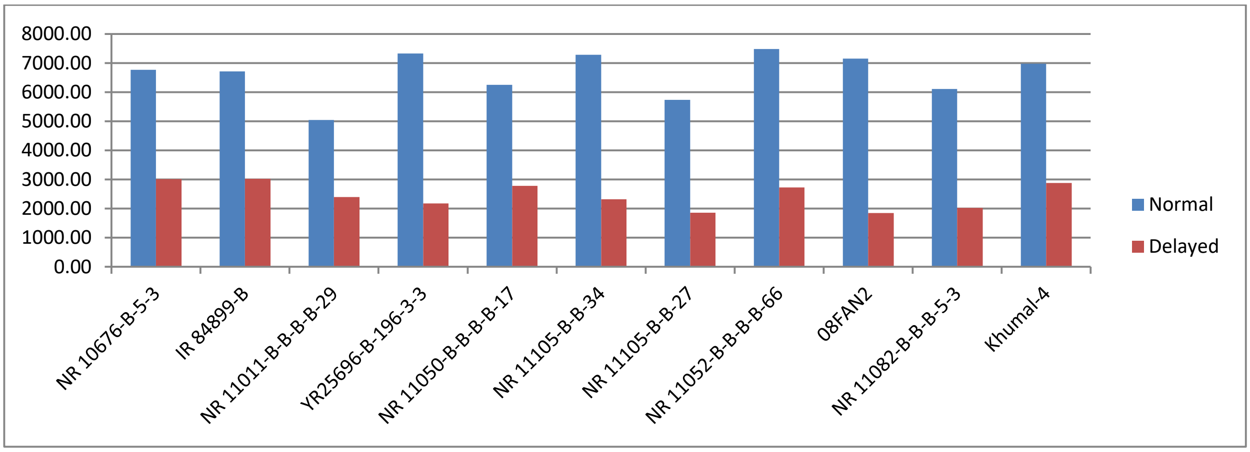

Figure 4. Grain yield of CVT rice genotypes under normal and delayed transplanting 2014.

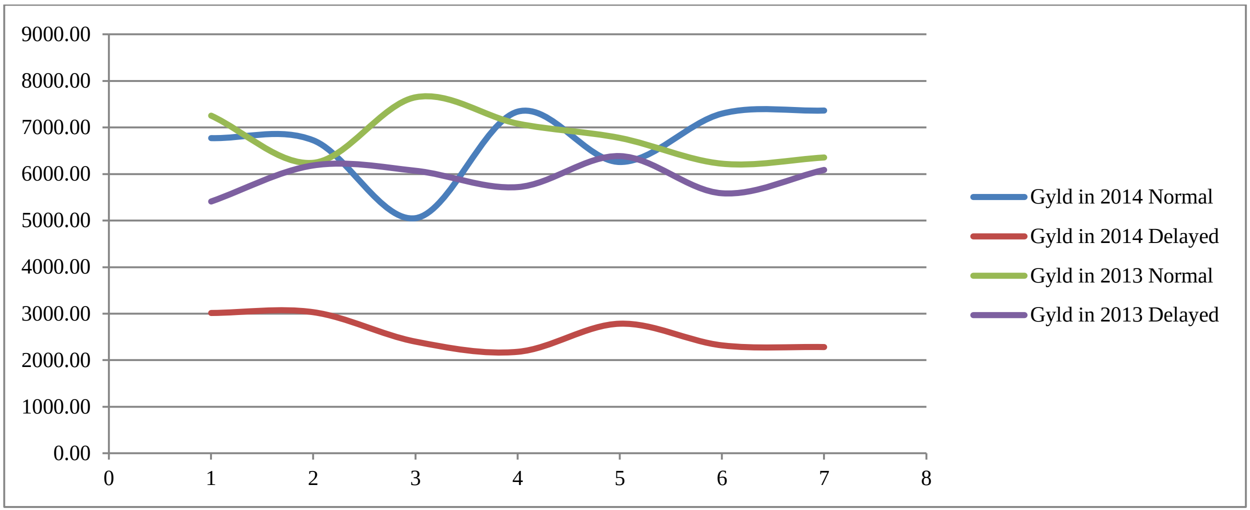

Figure 5. Comparision of grain yield between normal and delayed transplanting rice genotypes common in 2013 and 2014.

Conclusion

Comparision of different parameters of rice in 2013 and 2014 shows that late transplanted rice has always lower yield than normal transplanted rice which may be due to aged seedlings, improper root growth and development causing less absorption of nutrients from soil, shorter duration of photosynthesis during grain filling period and cold during grain maturation time. It is natural process that the crop which had taken more number of days from seeding to maturity might have a more vigorous and extensive root system, increased growth rate during vegetative growth, more efficient sink formation and greater sink size, greater carbohydrates translocation from vegetative plant parts to the spikelets and longer leaf area index during grain filling period.

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So this might be the possible reason to have high yields in earlier transplanting. Climate change and irratic rainfall pattern has pushed away the planting time of rice. Labor scarcity and delay in monsoon also causes delay in transplanting. Thus farmer's field have lower yield compared to experimental plot. The yield difference between experimental plot and farmer's field can be minimised by transplanting rice in appropriate time with recommended package of practices.

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