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Influence of crop establishment methods and weed management practices on profitability and nutrient uptake of Basmati rice (*Oryza sativa* L.)

Shipra Yadav, RB Yadav, RK Naresh, M Sharath Chandra and Rahul Kumar

Abstract
A field experiment was conducted at Crop Research Center of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut (U.P.), to study the effect of crop establishment methods and weed management options on weed dynamics and performance of Basmati rice (*Oryza Sativa* L.) during the *kharif* season of 2019 and 2020. The experiment was laid out in split plot design with three main factors *viz.*, (1) Conventional Puddled Transplanting (CPT), (2) Unpuddled Flat (UPF) and (3) Furrow Irrigated Raised Beds (FIRB) and five sub factors *viz.*, (1) Pretilachlor @ 0.75 Kg ha^{-1} PE *fb* Bispyribac sodium @ 20 g a.i. ha^{-1} POE at 20 DAT, (2) Almix 4 g a.i. ha^{-1} + Bispyribac sodium @ 20 g a.i. ha^{-1} POE at 20 DAT, (3) Bispyribac sodium @ 25 g a.i. ha^{-1} POE at 20 DAT, (4) Two hand Weedings and (5) Weedy check, the experiment was replicated by four replications. The effect of different crop establishment methods at different observation dates was significant. Yield, nutrient uptake and economics of rice was significantly influenced by crop establishment methods and weed management practices. Higher yield was found under conventional puddled transplanting which was significantly higher than the unpuddled flat and at par with furrow irrigated raised bed method during both the years. Among the weed management practices the highest yield was obtained with pretilachlor @ 0.75 Kg ha^{-1} *fb* Bispyribac sodium @ 20 g a.i. ha^{-1} which was statistically at par with Almix 4 g a.i. ha^{-1} + Bispyribac sodium @ 20 g a.i. ha^{-1} and two hand Weedings followed by Bispyribac sodium @ 25 g a.i. ha^{-1} in both the years. However lowest rice yield was obtained in weedy check. Highest NPK uptake was recorded under conventional puddled transplanting with the application of Pretilachlor @ 0.75 Kg ha^{-1} *fb* Bispyribac sodium @ 20 g a.i. ha^{-1}. The higher net return and B: C ratio was associated with the rice transplanted on furrow irrigated raised beds with Pretilachlor @ 0.75 Kg ha^{-1} *fb* Bispyribac sodium @ 20 g a.i. ha^{-1} was applied.

Keywords: Rice, nutrient uptake, crop establishment methods, weed management, profitability

1. Introduction

In India, rice occupies an area of 43.79 mha with production and productivity of 116.42 mt and 2.65 t/ha, respectively (Anonymous, 2019) [2]. Rice is reported to be one of the highly weed invaded crop and is ranked as second highest pesticide consuming crop after cotton. Rice crop suffers from various biotic and abiotic constraints. Weed competition is one of the prime yield-limiting biotic constraints in rice is weeds compete with crops for water, light, nutrients and space. Weeds are the most competitors in their early growth stages than at later stages and hence the growth of crops was suffered and finally reduced the grain yield (Jacob and Syriac, 2005) [11]. Weeds grow profusely in the rice field and reduce crop yields drastically normally the loss in yield range between 15-20% yet in severe cases the yield losses can be more than 50 per cent, depending upon the species and intensity of weeds. Weed flora under transplanted condition is very much diverse and consists of grasses, sedges and broad-leaved weeds causing yield reduction of rice crop up to 76 per cent (Singh *et al.*, 2004) [19]. The yield of transplanted rice in India is much lower than that of transplanted rice in other rice growing countries. Therefore, proper weed management is essential for satisfactory rice production in India. Herbicidal weed control has been gaining popularity in India in recent years. The main reasons are scarcity of labour during peak growing season, and also lower weeding cost by using herbicides. Most of the introduced herbicides are selective and are specified to control only one or two types of weeds. Weeds have variable growth habits and life cycles and they even vary under different cultural practices. Therefore, the use of chemicals only cannot effectively control weeds in all situations (De Datta and Herdt, 1983) [8]. Effective weed control in transplanted rice is one of the major limitations hindering its wide spread cultivation. Manual removal of weeds is labour intensive tedious, back-breaking and does not ensure weed removal at critical stage of crop weed competition bring heavy reduction in growth and yield of the crop. Hence for transplanted rice, the chemical method of weed management is best suited as take care of weeds right from beginning of crop growth and is cost effective. Most of the herbicides recommended for rice is generally applied as pre-emergence to take care of weed during initial period. However, to have minimum competition between weeds and rice the weeds need to be kept below threshold level, especially during critical weed competition period. Therefore, a new herbicide may be more effective for this purpose. Results of the study revealed that, application of Pretilachlor @ 125% of the recommended dose applied as pre-emergence under continuous flooding provided better weed control efficiency in transplanted Boro rice. But, application of Pretilachlor at recommended dose as pre-emergence under continuous flooding contributed to higher crop dry matter production leading to higher grain yield and harvest index (Ahmed *et al.*, 2014) [1]. The present article is intended to know the effect of crop establishment methods and weed management practices on yield, nutrient uptake and economics of Basmati rice.

2. Methods and Materials

The field experiment was conducted at Crop Research Center of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut (U.P.), to study the effect of crop establishment methods and weed management options on weed dynamics and performance of Basmati rice (*Oryza Sativa* L.) during the *kharif* season of 2019 and 2020. The soil of the experimental field was sandy loam in texture and slightly alkaline in reaction. The soil was medium in available phosphorus and potassium but low in organic carbon and available nitrogen. The experiment was laid out in split plot design with three main factors *viz*., (1) Conventional Puddled Transplanting (CPT), (2) Unpuddled Flat (UPF) and (3) Furrow Irrigated Raised Beds (FIRB) and five sub factors *viz*., (1) Pretilachlor @ 0.75 Kg ha^{-1} PE *fb* Bispyribac sodium @ 20 g a.i. ha^{-1} POE at 20 DAT, (2) Almix 4 g a.i. ha^{-1} + Bispyribac sodium @ 20 g a.i. ha^{-1} POE at 20 DAT, (3) Bispyribac sodium @ 25 g a.i. ha^{-1} POE at 20 DAT, (4) Two hand Weedings and (5) Weedy check, the experiment was replicated by four replications.

The required quantities of N, P, K and Zn were applied by Urea, Diammonium Phosphate, Muriate of potash, Zinc sulphate, respectively. Half dose of nitrogen and full dose of other nutrients was applied as basal and rest nitrogen was applied in two equal splits at tillering and panicle initiation stages into the soil uniformly. A thin layer of water (approximately 3.0 cm) was maintained during the initial stage of crop growth for better establishment of seedlings and maximum 5.0 cm at tillering stage and later an intermittent irrigation at the time of panicle initiation, flowering and grain formation stage were applied. Water was drained out from the field one week before the harvesting of crop. In order to control stem borer, leaf hopper, Gundhi bug and other insects, the recommended insecticide as Cartap hydro chloride 4G was applied @ 20 kg ha^{-1}. Harvesting was done manually when the crop reached at full physiological maturity stage. First of all, the border rows were harvested and separated. Later, the crop from net plot area was harvested and sun dried. The harvested material from each plot was carefully bundled, tagged and brought to threshing floor. Threshing was done plot wise and grains were cleaned, dried and weighed separately for each net plot and computed to q ha^{-1} at 14% moisture level. The straw yield was obtained by subtraction grain yield from biological yield, also recorded plot wise after sun drying and computed to q ha^{-1}.

The data collected from the experiment was subjected to statistical analysis with the procedure of Split Plot Design as suggested by Cochran and Cox (1970) [6]. The standard error of mean was calculated and critical difference (C.D. at 5%) was worked out for comparing the treatment means, wherever “f” test was found significant.

3. Result and Discussion

3.1 Yield of rice

3.1.1 Grain yield (q ha^{-1})

Grain yield was significantly influenced by crop establishment methods. The effect of different crop establishment methods on grain yield was significant. The highest straw yield (44.91 and 46.26 q ha^{-1}) recorded under conventional puddled transplanting (E_1) which was significantly higher than the unpuddled flat (E_2) (37.23 and 39.93 q ha^{-1}) and at par with furrow irrigated raised bed method (E_3) (42.97 and 44.08 q ha^{-1}) in the year 2019 and 2020 respectively. Grain yield was also significantly influenced by weed management practices. The highest grain yield (47.36 and 49.48 q ha^{-1}) was obtained with pretilachlor @ 0.75 Kg ha^{-1} *fb* Bispyribac sodium @ 20 g a.i. ha^{-1} (W_1) which was statistically at par with Almix 4 g a.i. ha^{-1} + Bispyribac sodium @ 20 g a.i. ha^{-1} (W_2) and two hand Weedings followed by Bispyribac sodium @ 25 g a.i. ha^{-1} (W_3) in the year 2019 and 2020 respectively. About 58.54 and 59.87% increase in grain yield due to pretilachlor @ 0.75 Kg ha^{-1} *fb* Bispyribac sodium @ 20 g a.i. ha^{-1} (W_1) over weedy check during both the years. However, the lowest grain yield (27.72 and 29.62 q ha^{-1}) was obtained in weedy check (W_5). About 41.46 and 40.13% reduction in grain yield recorded due to weeds in both the year respectively.

There was no any significant interaction between crop establishment methods and weed management practices on grain yield. This might be due to the higher crop growth of rice in terms of foliage, large amount of photosynthesis, which act as source and helped in developing yield attributes due to low crop weed competition and finally the higher grain yield was obtained with the application of pre and post emergence herbicide, resulted in the highest grain yield. Similar findings were reported by Bhomik *et al.* (2000) [4], Sangeetha *et al.* (2009) [18] and Suganthi *et al*. (2010) [20].

3.1.2 Straw yield (q ha^{-1})

Straw yield was significantly influenced by crop establishment methods. The effect of different crop establishment methods on straw yield was significant. The highest straw yield (76.40 and 77.74 q ha^{-1}) recorded under conventional puddled transplanting (E_1) which was significantly higher than the unpuddled flat (E_2) (65.10 and 70.30 q ha^{-1}) and at par with furrow irrigated raised bed method (E_3) (73.22 and 73.82 q ha^{-1}) in the year 2019 and 2020 respectively. Straw yield was also significantly influenced by weed management practices. The highest straw yield (79.63 and 82.40 q ha^{-1}) was obtained with pretilachlor @ 0.75 Kg ha^{-1} *fb* Bispyribac sodium @ 20 g a.i. ha^{-1} (W_1)

which was statistically at par with Almix 4 g a.i. ha^{-1} + Bispyribac sodium @ 20 g a.i. ha^{-1} (W_2) and two hand weedings (W_4) followed by Bispyribac sodium @ 25 g a.i. ha^{-1} (W_3) in the year 2019 and 2020 respectively. About 79.12 and 81.78% increase in straw yield due to pretilachlor @ 0.75 Kg ha^{-1} *fb* Bispyribac sodium @ 20 g a.i. ha^{-1} (W_1) over weedy check (W_5) during both the years. However, the lowest straw yield (53.20 and 55.38 q ha^{-1}) was obtained in weedy check (W_5). About 33.19 and 32.79% reduction in straw yield recorded due to weeds in both the year respectively. There was no any significant interaction between crop establishment methods and weed management practices on straw yield.

Higher straw yield was due to more accumulation of dry matter (g m^{-2}) along with the highest plant height and number of tillers m^{-2}. The application of Pretilachlor @ 0.75 Kg ha^{-1} *fb* Bispyribac sodium @ 20 g a.i. ha^{-1} was recorded straw yield (79.63 & 82.40 q ha^{-1}) which was (49.23%) higher as compared to weedy check plots. Similar findings were reported by Prasad *et al.* (2001) [16] and Sabhajeet *et al.* (2020).

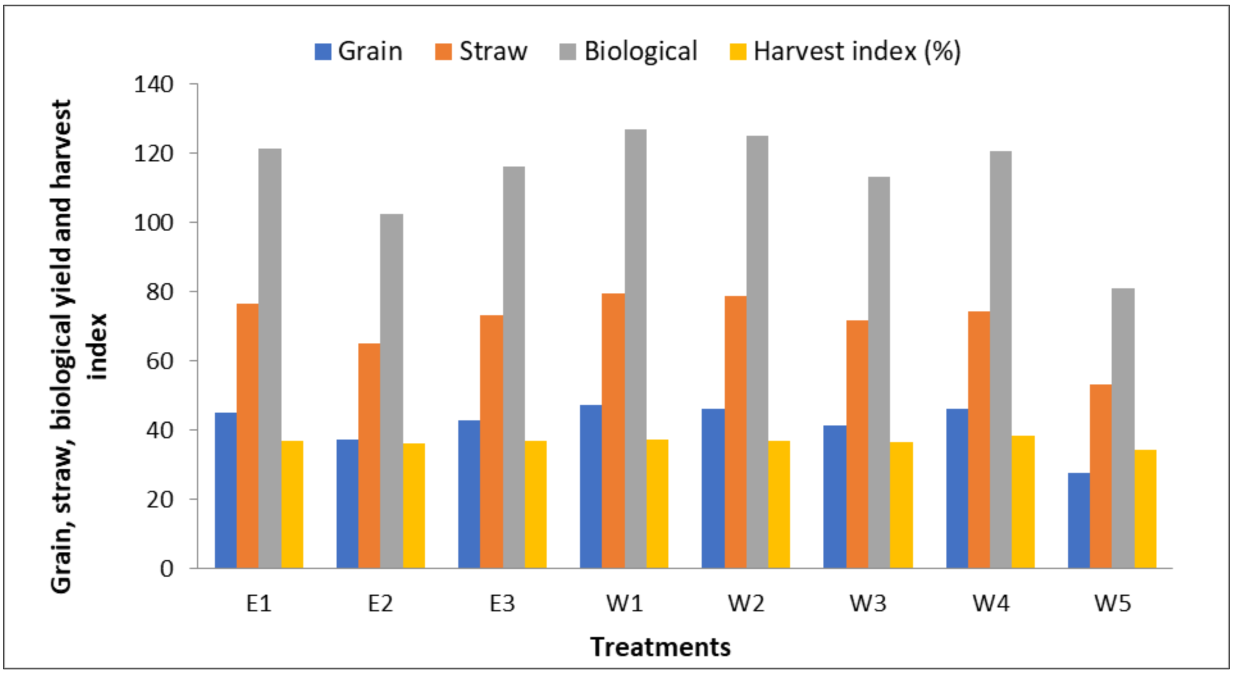

Fig 1a: Effect of establishment methods and weed management on grain, straw, biological yield and harvest index of Basmati rice (2019)

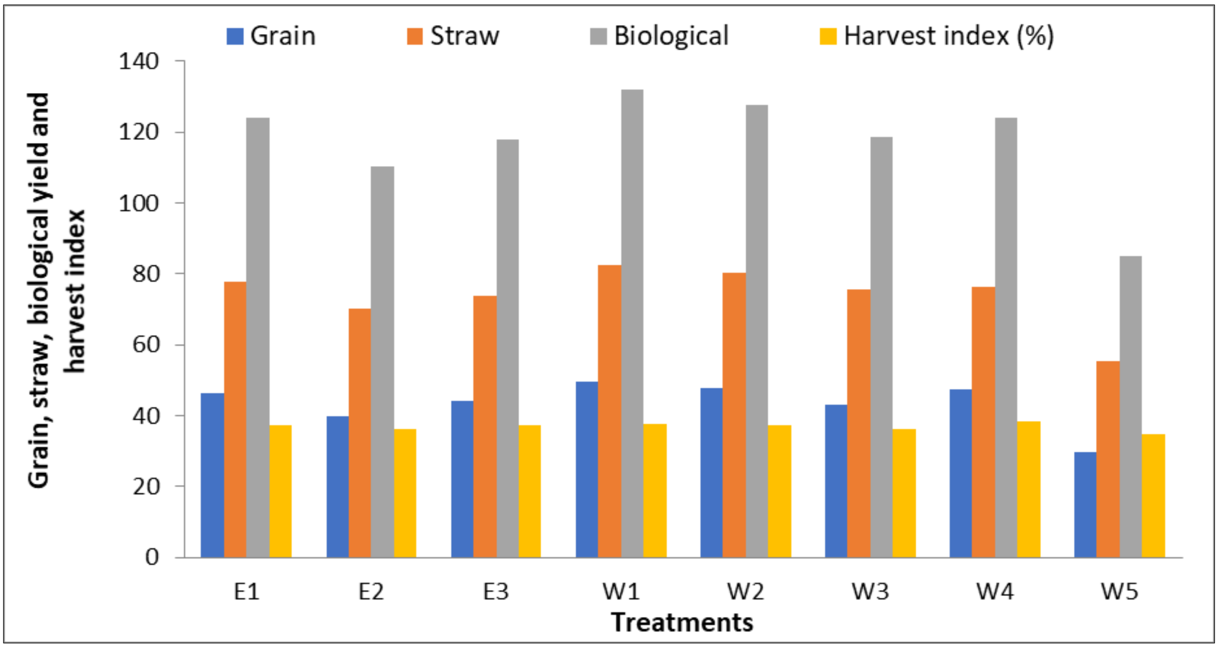

Fig 1b: Effect of establishment methods and weed management on grain, straw, biological yield and harvest index of Basmati rice (2020)

3.1.3 Biological Yield (q ha^{-1})

Biological yield was significantly influenced by crop establishment methods. The effect of different crop establishment methods on biological yield was significant. The highest biological yield (121.31 and 124.00 q ha^{-1}) recorded under conventional puddled transplanting (E_1) which was significantly higher than the unpuddled flat (E_2) (102.33 and 110.23 q ha^{-1}) and at par with furrow irrigated raised bed method (E_3) (116.19 and 117.90 q ha^{-1}) in the year 2019 and 2020 respectively. Biological yield was also significantly influenced by weed management practices.

The highest biological yield (126.99 and 131.88 q ha^{-1}) was obtained with pretilachlor @ 0.75 Kg ha^{-1} *fb* Bispyribac sodium @ 20 g a.i. ha^{-1} (W_1) which was statistically at par with Almix 4 g a.i. ha^{-1} + Bispyribac sodium @ 20 g a.i. ha^{-1} (W_2) and two hand weedings (W_4) followed by Bispyribac sodium @ 25 g a.i. ha^{-1} (W_3) in the year 2019 and 2020 respectively. About 64.32 and 64.05% increase in biological yield due to pretilachlor @ 0.75 Kg ha^{-1} *fb* Bispyribac sodium @ 20 g a.i. ha^{-1} over weedy check (W_5) during both the years However the lowest biological yield (80.92 and 85.00 q ha^{-1}) was obtained in weedy check (W_5). About 56.93 and 55.15% reduction in biological yield recorded due to weeds in both the year respectively. There was no any significant interaction between crop establishment methods and weed management practices on biological yield. Similar findings were reported by Suganthi *et al.* (2010) [20].

3.1.4 Harvest index (%)

Harvest index was non significantly influenced by crop establishment methods. The highest harvest index (36.90 and 37.17%) recorded under conventional puddled transplanting (E_1) which was higher than the furrow irrigated raised bed method (E_2) and unpuddled flat (E_3) in the year 2019-20 and 2020-21 respectively. Harvest index was significantly influenced by weed management practices. The highest harvest index (38.23 and 38.29%) was obtained with two hand weedings (W_4) which was statistically at par with pretilachlor @ 0.75 Kg ha^{-1} *fb* Bispyribac sodium @ 20 g a.i. ha^{-1} (W_1) and Almix 4 g a.i. ha^{-1} + Bispyribac sodium @ 20 g a.i. ha^{-1} (W_2) and followed by Bispyribac sodium @ 25 g a.i. ha^{-1} in the year 2019-20 and 2020-21 respectively. However, the lowest harvest index (34.21 and 34.81%) was obtained in weedy check. There was no any significant interaction effect among crop establishment methods and weed management practices.

3.2 Nutrient uptake by rice

3.2.1 Nitrogen uptake

The Data revealed that the nitrogen uptake in rice grain and straw was significantly influenced with crop establishment methods during both the years of experimentation. The maximum uptake of nitrogen (49.80 and 51.57) in rice grain, (33.02 and 34.33) in rice straw and total uptake were recorded under conventional puddled transplanting (E_1) followed by furrow irrigated raised bed method (E_3). However, the lowest nitrogen uptake in grain and straw (40.52, 43.83 and 27.45, 30.32) was found under unpuddled flat method (E_2) during 2019 and 2020, respectively.

The weed management practices also had significant effect on nitrogen uptake (in grains, straw and total) during both the years. The maximum nitrogen uptake (55.89 and 58.82) in grain, (38.91 and 41.03) in straw and total uptake were recorded with Pretilachlor @ 0.75 Kg ha^{-1} *fb* Bispyribac sodium @ 20 g a.i. ha^{-1} (W_1) followed by Almix 4 g a.i. ha^{-1} + Bispyribac sodium @ 20 g a.i. ha^{-1} (W_2), two hand weedings (W_4) and Bispyribac sodium @ 25 g a.i. ha^{-1}(W_4). However, the lowest nitrogen uptake (26.36, 28.43 and 18.53, 17.89) in grain and straw was found under weedy check (W_5) during 2019 and 2020, respectively. There was no any significant interaction effect between crop establishment methods and weed management practices on nitrogen uptake.

Table 3: Effect of establishment methods and weed management on nutrient uptake (kg ha^{-1}) by Basmati rice

Treatments	Nitrogen uptake (kg ha^{-1})		Phosphorus uptake (kg ha^{-1})		Potassium uptake (kg ha^{-1})	
	2019	2020	2019	2020	2019	2020
(E) Crop Establishment Methods						
E_1- Conventional Puddled Transplanting (CPT)	82.82	85.90	28.59	31.09	120.80	131.84
E_2-Unpuddled Flat (UPF)	67.97	74.15	23.46	27.13	100.67	115.60
E_3-Furrow Irrigated Raised Beds (FIRBs)	82.24	83.82	27.60	30.15	117.62	126.08
SE(m)±	*1.18*	*0.66*	*0.16*	*0.43*	*2.11*	*1.77*
C.D(P=0.05)	*4.09*	*2.30*	*0.58*	*1.50*	*7.32*	*6.15*
(W) Weed Management Options						
W_1-Pretilachlor @ 0.75 Kg ha^{-1} PE *fb* Bispyribac sodium @ 20 g a.i. ha^{-1} POE at 20 DAT	94.80	99.84	31.80	34.60	134.03	145.90
W_2-Almix 4 g a.i. ha^{-1} + Bispyribac sodium @ 20 g a.i. ha^{-1} POE at 20 DAT	88.36	91.70	29.63	32.90	128.33	138.23
W_3-Bispyribac sodium @ 25 g a.i. ha^{-1} POE at 20 DAT	76.13	80.82	25.16	28.61	112.64	124.79
W_4-Two hand Weedings	84.21	87.76	28.48	31.53	120.03	130.19
W_5-Weedy check	44.89	46.32	17.69	19.65	70.11	83.43
SE(m)±	*1.18*	*1.08*	*0.50*	*0.51*	*1.91*	*2.36*
C.D(P=0.05)	*3.52*	*3.23*	*1.50*	*1.51*	*5.68*	*7.02*

3.2.3 Phosphorus uptake

The Data revealed that, the phosphorus uptake in rice grain, straw and total were significantly influenced with crop establishment methods during both the years of experimentation. The maximum uptake of phosphorus (15.60 and 17.57) in rice grain, (13.00 and 13.52) in rice straw and total uptake (28.59 and 31.09) were recorded under conventional puddled transplanting (E_1). However, the lowest phosphorus uptake in grain and straw (12.72, 14.99 and 10.71, 12.14) was found under unpuddled flat method (E_2) during 2019 and 2020, respectively.

The weed management practices had significant effect on phosphorus uptake (in grains, straw and total) during both the years. The maximum phosphorus uptake (17.54 and 20.02) in grain, (14.25 and 14.57) in straw and total uptake were recorded with Pretilachlor @ 0.75 Kg ha^{-1} *fb* Bispyribac sodium @ 20 g a.i. ha^{-1} (W_1) followed by Almix 4 g a.i. ha^{-1} + Bispyribac sodium @ 20 g a.i. ha^{-1} (W_2), two hand Weedings (W_4) and Bispyribac sodium @ 25 g a.i. ha^{-1} (W_3). However, the lowest phosphorus uptake (9.12, 10.33 and 8.57, 9.32) was found under weedy check (W_5) during 2019 and 2020, respectively. There was no any significant interaction between crop establishment methods and weed management practices on phosphorus uptake by rice.

3.2.4 Potassium uptake
The Data revealed that, the maximum uptake of potassium (19.72 and 21.97) in rice grain, (101.07 and 109.87) in rice straw and total uptake (120.80 and 131.84) were recorded under conventional puddled transplanting (E_1). However, the lowest potassium uptake in grain and straw (16.15, 18.12 and 84.52, 97.49) was found under unpuddled flat method (E_2) during 2019 and 2020, respectively.
The weed management practices had significant effect on potassium uptake during both the years. The maximum potassium uptake (23.16 and 24.28) in grain, (110.87 and 121.62) in straw and total uptake were recorded with Pretilachlor @ 0.75 Kg ha^{-1} *fb* Bispyribac sodium @ 20 g a.i. ha^{-1} (W_1) followed by Almix 4 g a.i. ha^{-1} + Bispyribac sodium @ 20 g a.i. ha^{-1} (W_2), two hand weedings (W_4) and Bispyribac sodium @ 25 g a.i. ha^{-1} (W_3). However, the lowest potassium uptake (7.54, 11.23 and 62.58, 72.20) was found under weedy check (W_5) during 2019 and 2020, respectively.
The higher NPK uptake was mainly because of higher grain and straw yield in E_1 followed by E_3 compared to E_2 during experimentation. Similar trend has been observed by Bhuyan *et al.* (2012) [5]; Naresh *et al.* (2014) [14]. This was also perhaps due to more dry matter production by crop and less nutrient (N, P and K) depletion by weeds and subsequently more availability of these nutrients to crop. Pretilachlor *fb* Bispyribac sodium reduced the uptake of nutrient by weeds and increased by crop which resulted in higher grain and straw yield and it significantly superior over rest of the treatments in rice crop Barla *et al.* (2021) [3].

3.3 Economics of rice
3.3.1 Gross return
In term of gross return, among the different crop establishment methods, the highest gross return was recorded in conventional Puddled transplanted rice (E_1) followed by furrow irrigated raised beds (E_3) and it was lowest in unpuddled flats (E_2) during both the year of study. This may be because of comparatively higher increase in grain yield. In term of different weed management options, the highest gross return was recorded in Pretilachlor @ 0.75 Kg ha^{-1} PE *fb* Bispyribac sodium @ 20 g a.i. ha^{-1} (W_1) followed by Almix 4 g a.i. ha^{-1} + Bispyribac sodium @ 20 g a.i. ha^{-1} (W_2) and Two hand weedings (W_4) and the lowest gross return was recorded in Weedy check (W_5) during both the year of study.

3.3.2 Net return
Among the different crop establishment methods, the highest net return was recorded in furrow irrigated raised beds (E_3) followed by conventional puddled transplanted rice (E_1) and it was lowest in unpuddled flats (E_2) during both the year of study. In term of different weed management options, the highest net return was recorded in Pretilachlor @ 0.75 Kg ha^{-1} PE *fb* Bispyribac sodium @ 20 g a.i. ha^{-1} (W_1) followed by Almix 4 g a.i. ha^{-1} + Bispyribac sodium @ 20 g a.i. ha^{-1} (W_2) and Two hand weedings (W_4) and the lowest gross and net return was recorded in Weedy check (W_5) during both the year of study.

Table 3: Effect of establishment methods and weed management on Economics of Basmati rice

Treatments	Economics of rice					
	Gross Return		Net Return		B:C	
	2019	2020	2019	2020	2019	2020
(E) Crop Establishment Methods						
E_1- Conventional Puddled Transplanting (CPT)	126527	130075	84534	86845	3.01	3.00
E_2-Unpuddled Flat (UPF)	105225	112911	68536	75184	2.86	2.99
E_3-Furrow Irrigated Raised Beds (FIRBs)	121027	123920	85214	87320	3.37	3.38
(W) Weed Management Options						
W_1-Pretilachlor @ 0.75 Kg ha^{-1} PE *fb* Bispyribac sodium @ 20 g a.i. ha^{-1} POE at 20 DAT	132726	138540	94922	99716	3.51	3.58
W_2-Almix 4 g a.i. ha^{-1} + Bispyribac sodium @ 20 g a.i. ha^{-1} POE at 20 DAT	129716	133345	92565	95174	3.50	3.50
W_3-Bispyribac sodium @ 25 g a.i. ha^{-1} POE at 20 DAT	115850	121073	78683	82886	3.12	3.17
W_4-Two hand Weedings	128508	132380	85397	88249	2.98	3.00
W_5-Weedy check	81164	86171	45573	49559	2.28	2.36

3.3.3 Benefit: Cost Ratio
Among the different crop establishment methods, the B:C ratio was highest in furrow irrigated raised beds (E_3) followed by conventional puddled transplanted rice (E_1) and it was lowest in unpuddled flat plots during both the year. Among weed management options highest B:C ratio was observed with the application of Pretilachlor @ 0.75 Kg ha^{-1} PE *fb* Bispyribac sodium @ 20 g a.i. ha^{-1} (3.96 & 4.00) in the year 2019 and 2020, respectively. The lowest B:C ratio was associated with weedy check (W_5) during both the year of study.
Slightly higher gross income, net profit and B: C ratio recorded was during 2020 than 2019 because of comparatively higher grain productivity of rice grain with very less inflection cost of cultivation during both the years. Different crop establishment practices increased the cost of cultivation, gross income, net profit and B:C ratio because of more increase in grain yield and gross income in comparison to increase in cost of cultivation. Among the different crop establishment methods, the highest cost of cultivation and gross return were recorded under conventional puddled transplanted rice (E_1) while, the highest net profit and B: C ratio were recorded under furrow irrigated raised bed method (E_3). This may be because of higher efficiency of systems than other establishment methods. Similar trend has been observed by Hussain *et al.* (2013) [10] and Gupta and Sayre (2007) [9].
Among herbicides treatment, the higher gross returns (Rs. 132726 and 138540 ha^{-1}) and net returns (Rs. 99259 and 103968 ha^{-1}) were recorded in Pretilachlor @ 0.75 Kg ha^{-1} *fb* Bispyribac sodium @ 20 g a.i. ha^{-1}, which was found statistically at par with the application of Almix 4 g a.i. ha^{-1} + Bispyribac sodium @ 20 g a.i. ha^{-1} i.e., gross returns (Rs. 129716 and 133343 ha^{-1}) and net returns (Rs. 96891 and 99414 ha^{-1}). The lowest gross returns (Rs. 81164 and 86171 ha^{-1}) observed in weedy check during both the years, respectively. These findings are in close agreement with the results of Nivetha *et al.* (2017) [15], Suria *et al.* (2011) [21] and Dash *et al.* (2016) [7]. Among herbicides treatment, the higher B: C Ratio (3.96 and 4.00) was recorded in Pretilachlor @

0.75 Kg ha^{-1} *fb* Bispyribac sodium @ 20 g a.i. ha^{-1} followed by application of Almix 4 g a.i. ha^{-1} + Bispyribac sodium @ 20 g a.i. ha^{-1} i.e., (3.94 and 3.92). The lowest B: C ratio observed in weedy check treatment (2.59 and 2.65) during both the years, respectively. Marasini *et al.* (2020) [12] and Mondal *et al.* (2018) [13] also reported similar results.

4. Conclusion

The data recorded from two-year field experiment revealed that basmati rice crop gave the highest yield under conventional puddled transplanted condition with the application of Pretilachlor @ 0.75 Kg ha^{-1} PE *fb* Bispyribac sodium @ 20g a.i. ha^{-1} POE at 20 DAT, while the highest net return was recorded under furrow irrigated raised beds. Therefore, it can be concluded that transplanting of basmati rice on furrow irrigated raised beds and the application of Pretilachlor @ 0.75 Kg ha^{-1} PE *fb* Bispyribac sodium @ 20 g a.i. ha^{-1} POE at 20 DAT might be a better option to get higher yield and effective weed control in rice.

5. References

1. Ahmed MR, Bari MN, Haque MM, Rahman GKM. Effect of herbicide dose and water management on weed control efficiency and yield performance of boro rice. Journal of Science Foundation 2014;12(2):145-153.
2. Anonymous. Agriculture Statistics at a glance. Directorate of economics and statistics Department of Agriculture and cooperation Ministry of agriculture Govt. of India New Delhi 2019.
3. Barla S, Upasani RR, Beck AM. Performance of direct seeded rice under difference nutrient and weed management practices. Indian Journal of weed science 2021;53(2):135-141.
4. Bhowmik MK, Ghosh RK, Pal D. Bio-efficacy of new promising herbicides for weed management in summer rice. Indian Journal of Weed Science 2000;32(1, 2):32-58.
5. Bhuyan MHM, Ferdousi R, Iqbal MT. Yield and Growth Response to Transplanted Aman Rice under Raised Bed over Conventional Cultivation Method. ISRN Agronomy 2012;6(1):1-8.
6. Cochran WG, Cox GM. Experimental Designs. John Wiley Publishers. New York 1970.
7. Dash S, Malik GC, Banerjee M, Sethi D. Effect of different weed management practices in Boro rice cultivation. Advances in Life Sciences 2016;5(4):1351-1355.
8. De Datta SK, Herdt RW. Weed Control Technology in Irrigated Rice. IRRI, Los Banos, Laguna, Philippines, 1983, 89-108.
9. Gupta RK, Sayre K. Conservation agriculture in South Asia. Journal of Agricultural Science 2007;145(3):207-214.
10. Hussain S, Ramzan M, Rana MA, Mann RA, Akhter M. Effect of various planting techniques on yield and yield components of rice. Journal of Animal & Plant Sciences 2013;23(2):672-674.
11. Jacob D, Syriac EK. Performance of transplanted scented rice (Oryza sativa L.) under different spacing and weed management regimes in southern Kerala. J. Tropical Agric 2005;43(1, 2):71-73.
12. Marasini D, Sah SK, Marahatta S, Dhakal S. Weed dynamics and productivity of dry direct seeded rice in relation to tillage and weed management practices. Journal of Agriculture and Forestry University 2020;4:101-108.
13. Mondal D, Ghosh A, Bandopadhyay P, Ghosh RK. Influence of herbicide mixture on composite weed flora and yield of transplanted rice under system of rice intensification. Journal of Hill Agriculture 2018;9(1):49-54.
14. Naresh RK, Tomar SS, Samsher P, Singh SP, Kumar D, Dwivedi A, *et al*. Experiences with rice grown on permanent raised beds: effect of water regime and planting techniques on rice yield, water use, soil properties and water productivity. Rice Science 2014;21(3):170-180.
15. Nivetha C, Srinivasan G, Shanmugam PM. Effect of Weed Management Practices on Growth and Economics of Transplanted Rice under Sodic Soil. International Journal of Current Microbiology and Applied Science 2017;6(12):1909-1915.
16. Prasad SM, Mishra SS, Singh SJ. Effect of establishment methods, fertility levels and weed management practices on rice (*Oryza sativa*). Indian Journal of Agronomy 2001;46(1):216-22.
17. Sabhajit S, Tabassum, Kumar R, Dev CM. Yield and economics of aerobic direct seeded upland rice (*Oryza sativa* L.) as effected by different weed control measures under Rice-Wheat (*Triticum aestivum* L.) system. *Journal of Crop and Weed* 2020;16(1):88-93.
18. Sangeetha M, Jayakumar R, Bharathi C. Effect of slow-release formulations of pretilachlor on growth and yield of lowland transplanted rice (*Oryza sativa* L.). *Green Farming* 2009;2(2):997-999.
19. Singh R, Singh G, Tripathi SS, Singh RG, Singh M. Effect of herbicides on weeds in transplanted rice. Indian Journal of Weed Science 2004;36(31):184-186.
20. Suganthi M, Kandasamy OS, Subbian P, Rajkumar R. Bioefficacy Evaluation and Residue Analysis of Pretilachlor for Weed Control in Transplanted Rice-Rice Cropping System. Madras Agriculture Journal 2010;97(4-6):138-141.
21. Suria J, Juraimi ASM, Rahman AS, Man MM, Selamat A. Efficacy and economics of different herbicides in aerobic rice system. African Journal of Biotechnology 2011;10(41):8007-8022.