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Agronomic Practices and Grain Yields of Basmati 370 Rice Variety under Common Farmer Husbandry Practices in Mwea Irrigation Scheme, Kenya: A Review

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ABSTRACT

Basmati 370 rice is the predominant commercial variety grown by nearly 95% of the farmers in Mwea Irrigation Scheme in Kenya. Farmers agronomic practices are varied and there exist limited systematically documented baseline data on farmers practices, yields and land productivity. This study seeks to establish the farmers practices and yields, compare with monthly crop establishment data and document Basmati 370 yields in Mwea. The scheme was divided into six units and structured questionnaire administered to determine the farmers practices, followed by field yield sampling to quantify productivity. Concurrently, field trails were conducted to establish growth and yield performance of Basmati 370 rice variety under research conditions. Survey results indicate that majority of the farmers (70%), practice random planting for rice crop establishment. Fertilizer use is moderate (50%) and types varied with DAP + MOP and SA (79%) as the preferred combinations. There was nearly 100% use of herbicides for weed control. Farmers field yields averaged 5.0 t/ha and this compared well with experimental yields of 5.5 t/ha, the highest being 6.0 t/ha, during the November cropping. Comparatively, Lower farmers' yields (5.0 t/ha) is attributed to inadequate agronomic practices. November cropping gave the highest yields but not different from August and September cropping and possibly the best establishment period. It can therefore be concluded that Basmati 370 rice yields 5.5t/ha in Mwea irrigation scheme.

Key words: Basmati 370, Mwea, Rice, Yield.

Rice (*Oryza sativa* L.) is a major staple crop for a majority of the population worldwide (FAOSTAT, 2016). More than 3.3 billion people in developing countries depend on rice for their calories (Zeigler, 2017). In Kenya, rice is the third most important food crop after wheat and maize and production meets less than 15% of the domestic demand with a national consumption estimated at 983,000 metric tonnes compared to an annual production of 181,000 mt (NRDS 2, 2019).

In Kenya, about 80% of the rice is grown under irrigated ecosystems, the largest of which is in Mwea Irrigation Schemes (NRDS 1, 2008). Mwea Irrigation Scheme is in Kirinyaga county with an established 28,600 acres of paddy rice (NIA, 2022). Annual mean temperature average is 23°C with a RH of 78% (Kihoro *et al.,* 2013). Soils are vertisols, black and cracking (Sombroek *,* 1982). Basmati 370 paddy rice is the main variety grown with an estimated total annual production of 180,160,000 metric tons, which is 64% of the total rice produced in Kenya (Economic Survey, 2025).

The main production season in Mwea is July to December and this is based on irrigation water availability (NIA, 2022). On irrigation water availability to enable all the farmers to equitably share the inadequate irrigation water resource (NIA, 2022). Sowing however is between July and August (Ngige, 2004). Predominantly, Basmati 370 rice variety is grown in Mwea (MRGM case report, 2020). Use of certified seeds and basal and top-dress inorganic fertilizers remain high at 61%, 82% and 93%, respectively (Muhunyu, 2012).

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In Mwea, Basmati 370 rice yields depends on the method of establishment, timing, agronomic practices and prevailing environmental conditions. The perod of June-July normaly experiences lower average temperatures (Fig 1). The effects of rice growth and yields as affected by environmental conditions have been reported (Ionebala *et al.,* 2023). Low temperatures have the effect of affecting pollen fertility (Ashkra and Krishna, 2023). There also exist variations in agronomic practices including fertilizer application rates and regimes (Muhunyu *et al*., 2012). Reported findings indicate that optimum fertilizer application is important for optimum growth, tillerimg and yields (Peng *et al*., 2010).

According to NIA (2022) the productivity of Basmati 370 is 3.95 t/ha, under continuous flooding and 21 Day old transplanting. Ndiiri *et al.,* (2017) reported average yields of 7.1 t/ha under System of Rice Intensification (SRI) (8-day old seedings with Alternate wetting and drying) and 5.3 t/ha under conventional flooding; 28-days old seedings, grown under continuous flooding. In a survey conducted within Mwea Irrigation Scheme in 2012, Muhunyu (2012), reported average yields of 5.5 t/ha, under monoculture and conventional continuous flooding system. He however noted that biotic and abiotic factors limited the upward potential. According to Matolo (2012), average grain yields of 14.85 t ha^{-1} was obtained under SRI conditions of 16 plants/m^2 and 14 days seedling transplanting. This was 70% higher than 8.7 t/ha, from conventional method of 25 plants/m^2, transplanting done at 21 days after sowing. Using varied Nitrogen levels, Njinju *et al.* (2018) recorded varied yields of between 4-5 -5.6 t/ha with N levels of 75 kg/ha recommended at optimum. According to Samejima *et al.,* (2020), Basmati rice yields are affected by the establishment period and the prevailing environmental condition at the time. Average yields of 8.8 t/ha, were obtained in October planting, while yields of less than 1.3 t/ha in March- April, transplanting period. The low results were attributed to the low temperatures during the June month leading to poor fertilization (Guo *et al.,* 2025). The reported research and farmers productivity data are varied and have not been systematically documented.

The objective of the study is to establish key farmers field practices and yields and compare with the research yields and document. This is based on the hypothesis that 'there are no differences between the farmers yields and research yields' in Mwea irrigation Scheme. In this study, farmers' field practices were surveyed, yield established and compared with a five-monthly cropping yield trials, to determine Basmati rice yields in Mwea Irrigation Scheme, during the year 2021/2022.

Experimental site

The survey and trials were conducted in Mwea Irrigation Scheme (MIS) and Mwea Irrigation Agricultural Development Centre (MIAD), respectively. during the months of August 2021 to January 2022, which is the main rice growing period in the area. MIAD is within MIS. The main cropping season is August-December although some farmers practice double cropping and harvest in May, just before the June cold season sets in.

Mwea Scheme is located at an altitude of about 1100 meters above sea level, with an annual average rainfall of 900 mm at 0°37′S and 37°27′E. The climate is tropical within agro-ecological zones (AEZ) Lower Midland 3 (LM3) and Lower Midland 4 (LM4). The rainfall pattern is bimodal with an annual mean of about 930 mm with 66% reliability. The average temperature in Mwea is 22°C. The soils are predominantly vertisols (black cotton soils), imperfectly drained.

Weather for the period

The average temperatures and relative humidity for the period are shown in Fig 1. During the period, average, minimum and maximum temperatures were 23.4°C, 17.4°C and 29.5°C, respectively. March 2022 had the highest average temperatures while August 2021, had the lowest. Average relative humidity was 75.6% with December (80.2%) and March (70.3%) being the most and least humid months, respectively.

Soil nutrient status in mwea irrigation scheme

The soil pH was 6.4, slightly acidic and optimum for rice growth. The nutrients P and K were generally low with averages of 6.0 ppm and 81 ppm, respectively. Levels of P were however high in parts of Tebere. There were optimum levels of N and organic matter in the soil. Based on the soil nutrient status, the recommended nutrient N, P and K application rates for the Basmati370 rice variety are; 80 Kg N, 60 Kg P_20 and 60 Kg K_20 per hectare (Wanjogu *et al.,* 1995).

Experimental design and treatments

The scheme was stratified into the existing six main units namely; Mwea, Thiba, Wamumu, Karaba, Tebere and Mutithi/Curukia (out-growers). A list of farmers, maintained by IWUA, was obtained and 180 farmers, 30 each, from each unit selected in a sequence of 10; 1st,10 and 300th.

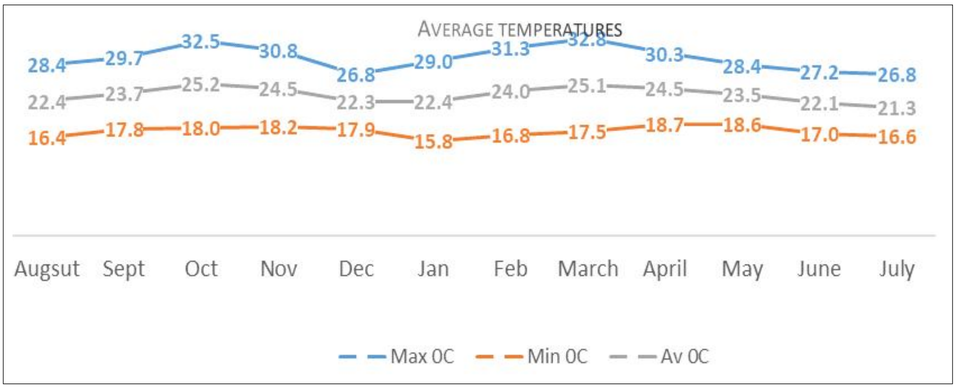

Fig 1: Average temperatures for the cropping period.

Where a farmer was missing or land left to a leasee, the next was selected. Whereas the list indicated 5,576 farmers, Leasee farmers were eliminated, leaving 2,240 farmers. A structured questionnaire was administered to establish the common agronomic practices. The questionnaire was pre-tested and anomalies corrected, prior to final administration. In addition, three, 1 m^2 quadrant yield samples in a transect method, were taken from each of the farmers' plots, threshed, weighed, moisture content recorded and yield determines at 14% moisture content, using the formula:

$$\text{Yield} = (100\text{-MC})/86 \times \text{yield obtained}$$

A concurrent field experiment was conducted at MIAD Centre during August to January. The period is the main cropping season, within the existing bimodal rainfall pattern and outside the cold season of June-July. January crop is harvested in May, at the onset land preparation for the main season. Basmati 370 rice variety seeds, sourced from MIAD Centre, was established in a monthly field trial, from August 2021 to January 2022. One (1) seedling each/hill, was planted at 21 days, at a spacing of 20 × 20 cm, in plot sizes measuring 3×3 m, in RCB design, with three replications, every 20th day of the month. The nutrients N, P and K were applied at MIAD standard rates of 80 Kg N ha^{-1}, 60 Kg P_2O_5 ha^{-1} and 60 Kg K_2O ha^{-1} (Wanjogu *et al*., 1995). Nutrient P and K were applied as basal during transplanting, while N was applied in splits, at 21 and 53 days after transplanting. Other agronomic practices were as per MIAD recommendations.

Data collection

A structured questionnaire administered provided information on crop establishment, fertilizers and herbicides used within the scheme. The total paddy harvest from each of the farmers' one-acre plots, were weighed, moisture content recorded and yield determined at 14% moisture content. From the field experiments, plant height, tillers, grain weight, root biomass and grain yields were recorded, at 28, 45, 65, these being; active tillering, maximum tillering and heading stages of rice, respectively. Weather and soil data were also obtained from the MIAD research Centre.

Data analysis

Qualitative data analysis was done using SPSS version 10 and results were tabulated using frequency Tables. Quantitative data were subjected to analysis of variance using Statistical Analysis System, SAS (version 9.0) and Post hoc analysis, where there was significance, carried out using the Least Significant Difference test at $p \leq 0.05$.

Out of the targeted 180 farmers 167 were interviewed and crop samples obtained from their fields.

Paddy rice establishment

Paddy rice establishment is predominantly random (68%) by the farmers, majority 96.3% of whom transplant in the month of August (Table 1). Comparatively, low yields are experienced under random transplanting.

Herbicide use for weed control in mwea paddies

Nearly 100% of the farmers in MIS, were noted to be using herbicide for weed control. About 35% of the respondents reported using a combination of both early post emergent and late post emergent herbicide while 56% use only early post emergent herbicides (as 2,4-D). Use of Methsulfuron (as Topshot) was comparatively high at 35.3%. Correlation results indicate that a combination of Twiga+Dicopur gave higher yields, comparable to Pirata herbicide application (Table 2).

Fertilizer use among farmers

Fertilizer usage among farmers in MIS is shown in Table 3. About 85% of the farmers reported using basal fertilizers, containing the nutrient P and K, for crop establishment. The most predominant combination source of the nutrients P and K, was; DAP+MOP (40%), followed by TSP+MOP (24%). On sectional comparison, more farmers in Thiba (22%) followed by Wamumu (18%) and Karaba (16%), were using basal fertilizers. Mutithi section (out-growers) had the least percentage (12%) of basal fertilizer usage. The predominant fertilizer used (80%) for top dressing was Sulphate of Ammonia while use of Urea for top dressing was low (9.6%) among farmers (Table 3).

Grain yields in farmers' fields

Farmers' grain yields and corresponding fertilizers use is shown in Table 4,5,6 and 7. The average grain yield was 5.0 t/ha. There were significantly lower yields in Karaba (4.3t/ha) and Mutithi/out growers (4.54 t/ha). Other sections were indifferent with respect to grain yields. About 40% of the respondents reported average yields of 5.1 t/ha, 20% got average yields of 5.3 t/ha, while 16% had average 5.8 t/ha. Comparatively, more farmers in Tebere (27%) obtained higher yields (5.3 t/ha) followed by Thiba and Wamumu (20% each). Generally, farmers in Thiba section had higher grain yields, followed by Wamumu sections. Correlation analysis indicates that majority of the farmers use of DAP + MOP (70%) and SA for topdressing with optimum yields of 5.6 t/ha (Table 8).

Table 1: Method, yield and time of crop establishment.

Method	n	%	Yld t/ha	Time of transplanting	n	%
Random	113	67.7	4.8	July	161	96.3
Line	54	37.7	5.3	August	6	3.7
Total	167	100.0			167	100

Table 2: Herbicide use and its correlation with yields in Mwea.

Herbicides used	n	%	Yield (t/ha)
Topshot	43	25.7	5.1-5.5
Twigamethoate	9	5.4	3.1-3.5
panida	2	1.2	5.1-5.5
Pirata	3	1.8	6.0-6.5
Dicopur	37	22.2	5.1-5.5
Tshot+Dicopur	16	9.6	5.1-5.5
Twiga+Dicopur	25	15.0	6.0-6.5
Panida+Dicopur	13	7.8	5.6-6.0
Pirata+Dicopur	1	0.6	4.6-5.0
N/A (No use of herbicides)	18	10.8	
Total	167	100	

Table 3: Fertilizer use and yield correlation.

Unit	DAP	TSP	SSP	23:23:00	DAP+ MOP	TSP+MOP	SSP+MOP
Mwea	7.7%	8.3%	0.0%	0.0%	7.5%	25.0%	44.4%
Thiba	15.4%	16.7%	0.0%	8.3%	30.0%	25.0%	33.3%
Wamumu	7.7%	25.0%	0.0%	16.7%	25.0%	20.8%	22.2%
Karaba	46.2%	41.7%	0.0%	0.0%	12.5%	4.2%	22.2%
Tebere	15.4%	8.3%	0.0%	41.7%	10.0%	16.7%	0.0%
Mutithi	7.7%	8.3%	0.0%	8.3%	7.5%	16.7%	11.1%

Unit	11:23:0+MOP	23:23:0+MOP	Others	MOP	n	% Total
Mwea	5.0%	20.0%	15.4%	11.1%	11	6.7%
Thiba	5.0%	40.0%	30.8%	44.4%	37	22.6%
Wamumu	10.0%	0.0%	23.1%	22.2%	30	18.3%
Karaba	35.0%	20.0%	0.0%	0.0%	28	17.1%
Tebere	20.0%	20.0%	7.7%	0.0%	24	14.6%
Mutithi	20.0%	0.0%	30.8%	11.1%	20	12.2%
					164	100.0%

Table 4: Basmati rice yields in Mwea.

Unit	Grain yield (t/ha)
Mwea	5.41
Thiba	5.19
Wamumu	5.18
Karaba	4.54
Tebere	5.35
Out-growers	4.32
Mean	5.00
P-value (0.05)	0.0001
CV (%)	19.8
LSD	0.52

Basmati 370 growth and yield in field trials

Plant height variation during the period

Growth and yield data for the experimental period of August to January 2021/2022 are shown in Table 9. There were significant differences in growth and yield parameters during the period. The average plant height was 119 cm with the tallest plant height attained is 125 cm from the September cropping. The shortest plant height attained was 108 cm during the November cropping.

Tillers numbers

November cropping gave the highest significant tiller numbers (31.9), followed by the August crop (23.6), while the least was in October (17.1). There were no Significant ($p\leq0.05$) differences in the number of tillers for the months of September, October and December sowing. About 90% of the tillers were productive.

Root biomass (gm)

Root biomass Significantly ($p\leq0.05$) varied for the period of study. The highest root biomass was for the crop sown in September while August cropping had the lowest biomass of 18.1 g/hill and 7.8 g/hill, respectively. The least Significant ($p\leq0.05$) root biomass was from the month of August, but this was not different from that of September and December.

Thousand-grain weight (gm)

The thousand-grain weight averaged 21.9 grams for the period. The highest significant ($p\leq0.05$) grain weight was

Table 5: Grain yields in Mwea scheme (Sign n= 167).

	Yield (t/ha)										
Section	2.5-3.0	3.1-3.5	3.6-4	4.1-4.5	4.6-5.0	5.1-5.5	5.6-6.0	6.0-6.5	6.6-7.0	7.1-7.5	n	Total
Mwea	0.0%	12.5%	18.2%	4.5%	16.1%	20.0%	14.8%	11.1%	33.3%	50.0%	25	15.0%
Thiba	0.0%	25.0%	0.0%	18.2%	35.5%	20.0%	29.6%	22.2%	16.7%	0.0%	37	22.2%
Wamumu	14.3%	0.0%	9.1%	22.7%	19.4%	14.3%	22.2%	27.8%	16.7%	0.0%	30	18.0%
Karaba	42.9%	37.5%	27.3%	22.7%	12.9%	17.1%	3.7%	11.1%	0.0%	50.0%	28	16.8%
Tebere	0.0%	0.0%	9.1%	18.2%	6.5%	25.7%	22.2%	16.7%	33.3%	0.0%	27	16.2%
Out-growers	42.9%	25.0%	36.4%	13.6%	9.7%	2.9%	7.4%	11.1%	0.0%	0.0%	20	12.0%
											167	100.0%

Table 6: Basal fertilizer application and grain yields. (n=167).

	Grain yields (t/ha)										
Fertilizer	2.5-3.0	3.1-3.5	3.6-4	4.1-4.5	4.6-5.0	5.1-5.5	5.6-6.0	6.0-6.5	6.6-7.0	7.1-7.5	n	%
DAP	42.9%	0.0%	25.0%	9.1%	9.7%	3.0%	7.7%	0.0%	0.0%	0.0%	13	7.90%
TSP	0.0%	25.0%	12.5%	13.6%	3.2%	6.1%	7.7%	5.6%	0.0%	0.0%	12	7.30%
SSP	0.0%	12.5%	0.0%	0.0%	0.0%	0.0%	0.0%	11.1%	16.7%	50.0%	5	3.0%
23:23:0	14.3%	0.0%	0.0%	4.5%	0.0%	12.1%	15.4%	5.6%	16.7%	0.0%	12	7.30%
DAP+MOP	28.6%	0.0%	25.0%	22.7%	22.6%	30.3%	34.6%	16.7%	33.3%	0.0%	40	24.40%
TSP+MOP	14.3%	37.5%	25.0%	18.2%	9.7%	12.1%	11.5%	16.7%	16.7%	0.0%	24	14.60%
SSP+MOP	0.0%	0.0%	0.0%	4.5%	6.5%	6.1%	7.7%	11.1%	0.0%	0.0%	9	5.50%
23:23:0+MOP	0.0%	0.0%	12.5%	0.0%	0.0%	3.0%	7.7%	5.6%	0.0%	0.0%	5	3.05%
11:23:0+MOP	0.0%	0.0%	25.0%	9.1%	19.4%	21.2%	0.0%	11.1%	0.0%	50.0%	20	12.20%
Others	0.0%	25.0%	12.5%	9.1%	12.9%	0.0%	3.8%	11.1%	16.7%	0.0%	13	7.93%
MOP	0.0%	0.0%	0.0%	9.1%	16.1%	6.1%	3.8%	5.6%	0.0%	0.0%	11	6.71%

obtained in October, but this was not different from the August and September cropping. The month of December had the least significant grain weight.

Grain yields (t/ha)

The effect of time of sowing on grain yield is shown in Table 9. December cropping had the least yields due to effect of bird pest thus considered an outlier. There were significant ($p<0.05$) differences in grain yield during the period. The average grain yield was 5.5 t/ha. November cropping had the highest significant grain yields (6.0 t/ha), but this was not different from August (5.9 t/ha) and September (5.6 t/ha) yields. The lowest significant yield was during the December off-season crop (1.3 t/ha). Grain yields had a sigmoid distribution with the highest proportion of farmers obtaining between 5.1-5.5 t/ha (Fig 2).

Majority of the farmers in Mwea (68%) establish rice through random (non-row) planting, with closer spacing and with a correspondingly lower yields. This may partly be attributed to the labour resource intensive requirement (IRRI, 2007). Random planting is associated with closer spacing, nutrient and space competition and corresponding lower yields (Banjade *et al*., 2023; Goswami *et al.,* 2020). Previous findings suggest that drudgery in rice crop establishment can be reduced by mechanization of transplanting (Hossen *et al*., 2022) and this is currently not available in Mwea Irrigation scheme. Fertilizer usage was moderate (50%) and varied in different sections. There was predominant use of a combination of DAP+ MOP, followed by SA for top dressing. This combination provides N, P and K, at rates of 80 Kg N/ha, 60 Kg P_2O_5/ha and 60 Kg K_2O/ha, which is the rate recommended for Basmati paddy rice variety in Mwea (Njinju *et al.,* 2018). This is adequate for Basmati 370 whose yield potential is 5.5 t/ha (Samejima *et al*., 2020; Muhunyu, 2012). The importance of proper nutrient management for optimum yields, previously been reported (Zingore *et al.,* 2022). In Tebere area, there was prevalent use of 23:23:0 as basal fertilizer. This may be associated with inherent high P and K levels in the soil (Table 10). Previous findings confirm the same (Onderi and Danga, 2021).

Results also indicate that there was predominant (89.2%) use of herbicides among the farmers for weed control. This is an efficient weed control method and is less labour intensive (Goswami *et al.,* 2020). In Mwea, where weeding has previously been manual, herbicide use reduces drudgery especially to the women, who are also in reproductive roles (JICA, 2015). Onderi and Danga (2021), reported similar findings. The use of herbicides is cheap, efficient and has less drudgery in weed control (Das *et al*., 2024).

Field trials indicated that crop establishment in November gave higher tillers numbers, root biomass and grain yields, but not different from that of August and September cropping in the parameters measured. December cropping was least in performance. Whereas rice growth and yield are affected by weather parameters

Table 7: Top dressing fertilizer and grain yields in Mwea irrigation scheme.

Fertilizer type	2.5-3 (t/ha)	3.1-3.5 (t/ha)	3.6-4 (t/ha)	4.1-4.5 (t/ha)	4.6-5.0 (t/ha)	5.1-5.5 (t/ha)	5.6-6.0 (t/ha)	6.0-6.5 (t/ha)	6.6-7.0 (t/ha)	7.1-7.5 (t/ha)	N	% usage
SA	57.1%	87.5%	81.8%	70.4%	77.4%	80.0%	77.8%	77.8%	83.3%	100.0%	133	79.6%
Urea	28.6%	0.0%	0.0%	3.7%	9.7%	8.6%	14.8%	16.7%	0.0%	0.0%	16	9.6%
CAN	14.3%	0.0%	18.2%	0.0%	0.0%	5.7%	7.4%	0.0%	0.0%	0.0%	7	4.2%
Others	0.0%	12.5%	0.0%	7.4%	12.9%	5.7%	0.0%	5.6%	16.7%	0.0%	11	6.6%
											167	100.0%

n=167; SA= Sulphate of ammonia; CAN= Calcium ammonium nitrate.

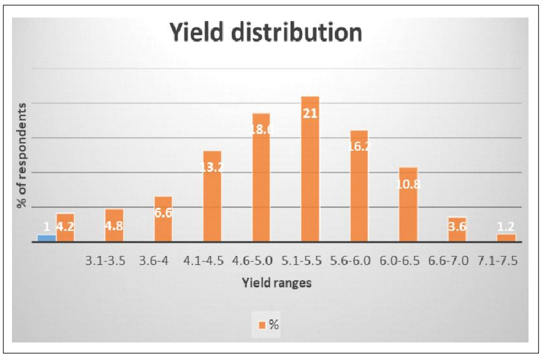

Fig 2: Distribution of grain yield.

(Ionebala *et al.*, 2023), weather data imply no clear variation to possibly affect performance. The dip in RH during grain filling, could however not significantly affect the December crop yield. Other factors could have been the cause.

Farmers and field trial yields averaged 5.0 t/ha and 5.5 t/ha, respectively. The farmers' yields were comparatively lower possibly due to differences in agronomic or cultural practices (Ionebala *et al.*, 2023; Muhunyu, 2012). Also, lower yields in sections of the schemes can be associated with inadequate irrigation water arising from lack of proper irrigation infrastructure (Abdullahi *et al.*, 2003). The average experimental yields of 5.5 t/ha is within reported previous findings (Samejima *et al.*, 2020; Onderi and Danga, 2021).

Table 8: Correlation between fertilizer use (basal, top-dressing) and grain yields.

Basal fertilizer	No. of farmers	%	yld t/ha	Top dress fertilizer	No. of farmers	%	yld t/ha
DAP	13	7.8	4.6-5.0	SA	133	79.6	5.1-5.5
TSP	12	7.2	3.1-4.5	Urea	16	9.6	5.6-6.0
SSP	5	3.0	6.0-6.5	CAN	7	4.2	5.1-5.5
23:23:0	12	7.2	5.6-6.0	Others	11	6.6	4.6-5.0
DAP+MOP	40	24.0	5.1-5.5				
TSP+MOP	24	14.4	5.1-5.0				
SSP+MOP	9	5.4	5.6-6.0				
23:23:0+MOP	5	3.0	5.6-6.0				
11:23:0+MOP	20	12.0	4.6-5.0				
Others	13	7.8	4.6-5.0				
MOP	11	6.6	4.6-5.0				
N/A	3	1.8					
	167	100			167	100	

Table 9: Monthly growth and yield parameters.

Month	Plant height (cm)	Tillers (No)	Productive tillers (No)	Root biomass (gm per hill)	1000 Gwt (gm)	Yld (t/ha)
August	113.1	25.4	23.6	7.8	20.0	5.9
Sept	125.0	17.1	16.2	8.1	21.2	5.6
Oct	111.2	20.8	18.9	17.0	21.8	4.3
Nov	108.8	31.9	30.5	18.1	21.5	6.0
Dec	119.9	18.3	15.5	10.3	19.8	(1.3)
Mean	119.2	23.1	20.9	12.3	20.9	5.5
P-Value	0.003	0.007	0.004	0.013	0.01	0.0002
CV (%)	4.2	15.9	16.4	27.4	2.6	15.2
LSD	9.4	6.9	6.5	6.3	1.0	1.31

NB: December yield treated as an out-lier, arising from bird pest damage.

Table 10: Soil nutrient status in the survey area.

	pH	P (ppm)	K (ppm)	N (%)
Mwea	5.6	1.9	48.1	0.218
Thiba	6.2	5.0	62.0	0.232
Wamumu	6.7	3.6	58.1	0.22
Karaba	7.4	6.6	76.4	0.22
Tebere	6.7	12.7	161.3	0.232

Soil sample results, ppm= Parts per million. Source: NIA/MIAD Laboratory.

The significantly high yields in the November crop can be attributed to higher tiller numbers, higher productive tillers and higher grain weight (Table 9). Lack of differences with August and September cropping indicates that August to November remain relatively good crop establishment period for optimum grain yields. It can be safely implied that the yield of Basmati 370 rice variety in Mwea Irrigation scheme is 5.5/ha.

CONCLUSION

The average yield of the Basmati 370 rice variety in the Mwea Irrigation Scheme is 5.5. t/ha with a potential of up to 6.0 t/ha. Good agronomic practices including using a combination of DAP+ MOP at the establishment and timely top-dressing with SA fertilizer are key. Whereas August is the main establishment period, better performance can be obtained by November cropping.

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Conflict of interest

The authors declare that there is no conflict of interest. The funding source had no role in the design of the study, in the collection, analysis, or interpretation of data, in the writing of the manuscript, or in the decision to publish the results.

REFERENCES

Abdullahi, M., Mizutani, M., Tanaka, S., Goto, A. and Matsui, H. (2003). Changes in water management practices in the Mwea irrigation scheme, Kenya from 1994 to 1998. *Rural Environment Engineering*. **44:** 60-67. doi: https:// doi.org/ 10.11408/ jierp1996.2003.44_60.

Ashkra, K.A.K. and Krishna, J.K. (2023). Estimating the Potential effect of climate change on rice yield in india by considering the combined effects of temperature and rainfall. *Bhartiya Krishi Anusandhan Patrika.* **38(3):** 284-289. doi: 10.1880 5/BKAP649.

Banjade, D., Khanal, D., Shreshta, A. and Shrestha, K. (2023). Effects of seedling and plant spacing on the system of rice intensification (SRI) for spring rice (*Oryza sativa* L. Chaite 2). *Agro-Environmental Sustainability*. **1(3):** 229-235. https://doi.org/10.59983/s2023010304.

Das T.K., Behera, B., Nath, C.P., Ghosh, S., Sen, S., Raj, R., Ghosh, S., Sharma, A.J., Yaduraju, N.T., Nalia, A., Dutta, A., Kumar, N., Singh, R., Pathak, H., Singh, R.G., Hazra, K.K., Ghosh, P.K., Layek, J., Patra, A. and Paramanik, B. (2024). Herbicides use in crop production: An analysis of cost-benefit, non-target toxicities and environmental risks. *Crop Protection.* pp 181.

Economic Survey (2025). Republic of Kenya, Kenya National Bureau of Statistics, Economic Survey 2025. https:// www.knbs.or.ke/reports/2025.

FAO, (2016). FAOSTAT Data; available at: http://faostat3. fao.org/ browse/FB/CC/E.

Goswami, R.G., Dutta, M. and Borgohai, S. (2020). Economic analysis of mechanical and manual transplanting of rice: A comparative study. *International Journal of Current Microbiology and Applied Sciences.* **9(7):** 392-396.

Guo, L., Du, X., Chang, J., Gong, J., Chu, Z. and Lv, J. (2025). Effects of low-temperature stress at different growth stages on rice physiology, pollen viability and yield in China's cold region. *PLoS One*. **20(8):** e0329441. https:// doi.org/10.1371/journal.pone.0329441.

Hossen, M.A., Shahriyar, M., Sharmin, I., Haimonti, P. and Mizanur M.R. (2022). Rice transplanting mechanization in Bangladesh: Way to make it sustainable. *Agricultural Sciences*. **13:** 130-149. https://www.scirp.org/journal/as ISSN Online: 2156-8561 ISSN Print: 2156-8553

Ionebala, H.D, Yaikhom, V., Singh I.R.K. and Satya, S. (2023). The effect of weather parameters on yield performance of some aromatic rice cultivars (*Oryza sativa* L.) of Manipur. *Indian Journal of Agricultural Research*. **59(2):** 219-226. doi: 10.18805/IJARe.A-6049.

IRRI (2007). Planting the Rice. Rice Knowledge Bank.
http://www.knowledgebank.irri.org/ericeproduction/II.6_Seedling_ and_plant_rate.htm.

Japan Internal Cooperation Agency (JICA). (2015). Gender study on Rice-Based Market Oriented Agriculture Promotion project, in Rice Enterprise Interventions in Mwea East and West Sub-counties, Kirinyaga county, in Kenya. www.https:// www.jica.go.jp/project/ english/kenya/ 010/materials/c8h0vm00009ijyig-att/pegres.pdf.

Kihoro, J., Bosco, N.J. and Murage, H. (2013). Suitability analysis for rice growing sites using a multicriteria evaluation and GIS approach in great Mwea region, Kenya. *Springer Plus*. **2:** 265. https://doi.org/10.1186/2193-1801-2-265.

Mwea Rice Growers Multipurpose Society (MRGM). (2020). Mwea Rice Growers Multipurpose Public Case Report. August 2020.

Matolo, N. (2012). A Comparative Assessment of SRI and Conventional Rice Production in Mwea Irrigation Scheme, Kenya. A Thesis submitted in partial fulfillment for the degree of Master of Science in Soil and Water Engineering in the Jomo Kenyatta University of Agriculture and Technology. JKUAT Repository Home,http://ir.jkuat.ac.ke›.

Muhunyu, J.G. (2012). Is doubling rice production in Kenya by 2018 achievable? *Journal of Developments in Sustainable Agriculture*. **7:** 46-54.

National Irrigation Authority (2022). Republic of Kenya, Ministry of Water Sanitation and Irrigation, Website, https://www. irrigation. go.ke/projects/mwea-irrigation-scheme.

National Rice Development Strategy 1 (2008-2018). Republic of Kenya, Ministry of Agriculture, http://www.fao.org/in-action/fapda;www.kilimo.go.ke.

National Rice Development Strategy 2 (2019-2030), Republic of Kenya, Ministry of Agriculture, Livestock Fisheries and Cooperatives. https://kilimo.go.ke/wp-content/uploads/ 2021/01/ NRDS-2-2019-2020-14-July.pdf.

Ndiiri, J.A. Uphof, N., Mati, B.M., home, P.G. and Odongo, B. (2017). Comparison of yields of paddy ric undr system of rice intensification in Mwea, Kenya. American *Journal of Plant Biology*. **2(2):** 49-60. https/doi.org/10.11648/ j.ajpo.20170202.12.

Ngige, K.J. (2004). An Economic Analysis of rice Production in Mwea Irrigation Scheme (Master's thesis). University of Nairobi Digital Repository, https://erepository.uonbi.ac.ke.

Njinju, S.M., Samejima, H., Katsura, K., Kikuta, M., Gweyi-Onyango, J.P., Kimani, J.M. and Makihara, D. (2018). Grain yield responses of lowland rice varieties to increased amount of nitrogen fertilizer under tropical highland conditions in central Kenya. *Plant Production Science*. **21(2):** 59-70. https://doi.org/10.1080/1343943X.2018.1436000.

Onderi, J.N. and Danga, B.O. (2021). Recycling Mwea irrigation water for sustainable agriculture. *African Journal of Environmental Agricultural Research Science and Technology*. **16(6):** 22 5-237.

Peng, S., Buresh, R.J., Huang, J., Zhong, X., Zou, Y., Yang, J.,Wang, G., Liuand, Y. and Hu, R.Q. (2010). Improving nitrogen fertilization in rice by site-specific N management: A review. *Agronomy for Sustainable Development.* **30:** 649-656.

Samejima, H., Katsura, k., Kikuta, M., Njinju, S.M., Kimani, J.M., Yamauchi, A. and Makihara, D. (2020). Analysis of rice yield response to various cropping seasons to develop optimal cropping calendars in Mwea-Kenya. *Plant Production Science*. **23(3):** 297-305. doi: 10.1080/1343943X.2020. 1727752.

Sombroek, W.G. (1982). International Soil Reference and Information Centre (ISRIC) Presented at the 5th International Soil Classification Workshop, Khartoum Sudan, November 1982.

Wanjogu, R.K., Mugambi, G., Adoli, H.L, Shisanya, S.O. and Tamura, M. (1995.) Mwea Rice Production Manual. p22.

Zeigler, R. (2017). Importance of Rice Science and World Food Security. American Society of Plant Biologists. Curated Webner, www. https://plantae.org/robert-zeigler-importance-of-rice-science-and-world-food-security/DOA 20.08.2022.

Zingore, S., Adolwa, I.S., Njoroge, S., Johnson, J., Saito, K., Phillips, S., *et al*. (2022). Novel insights into factors associated with yield response and nutrient use efficiency of maize and rice in Sub-Saharan Africa. A Review. *Agronomy for Sustainable Development*. 42, Article No. 82. https://doi.org/10.1007/s13593-022-00821-4.