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Assessment of paddy varieties for upland situation of Uttara Kannada district

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Abstract
On farm trials were conducted in Uttara Kannada district of Karnataka state during Kharif season in the year 2019 and 2020 to assess the performance of Farmers practice MTU-1001 (Technology Option -1), recommended variety MGD-101 (Technology Option 2) and Sahabagidhan (Technology Option -3) Short duration paddy variety. Pooled data of two years of on farm trial showed that Sahabagidhan paddy variety performed better than other two varieties. The higher plant height, number of tillers, panicle length, number grains per panicle, grain weight per panicle, grain yield and straw yield were recorded with Sahabagidhan paddy variety as compared to MTU-1001 and MGD-101. The gross returns, net return and B:C ratio were also higher in Sahabagidhan paddy variety. The pooled data indicated that there was increase of grain yield by 42.12% and straw yield by 30.53% over farmers practice variety MTU 1001. Similarly, the gross returns and net returns of Sahabagidhan variety were increased by 41.41% and 75.50% over MGD-101 and MTU 1001, respectively. Pooled data reported that there was reduction of incidence of insect pest *viz.*, stem borer, leaf folder, brown plant hopper and ear head bug and diseases *viz.*, blast, grain discoloration and smut with Sahabagidhan paddy variety. Whereas, MTU-1001 and MGD-101 recorded higher incidence of insect pest and disease.

Keywords: paddy, Sahabagidhan, growth and yield, economics

1. Introduction
Rice is the seed of the grass species *Oryza sativa* L. As a cereal grain, it is the most widely consumed staple food for a large part of the world's human population, and is considered as the "global grain". It is the agricultural commodity with the third highest worldwide production, after sugarcane and maize (Suthar, *et al*., 2016) [11] . Asian countries consume about 90 per cent of the rice grown and produced in the world. Rice is grown under varying environments ranging from flooded condition to upland rainfed ecosystem. About 42 per cent of cultivable land area in India is facing drought. Drought is the most widespread constraint in rice production affecting grain yield and quality (Venuprasad *et al.*, 2007) [12]. Uttara Kannada district has varied topographical soil condition and rainfall pattern is ideally suited for cereal, cash crops, horticultural and other plantation crops. Rice is one of the most important cereal crop which grown under rainfed situation in both low and upland situations. In lowland irrigated systems, high yielding varieties have reached an average productivity of 3 to 4 t ha-1, while in rainfed systems, adapted varieties produce hardly around 1 t ha-1 (Prasad, 2011) [8]. Additionally,
water scarcity is becoming a serious problem with global climate changes, which is a potential risk for rice productivity and food security (Li *et al.*, 2011) [6]. It is estimated that by 2025, 15 million hectares of traditionally irrigated land will suffer physical water scarcity and 22 million hectares will be under economic water scarcity (Prasad, 2011) [8]. In upland situations under rainfed situation, Many farmers are cultivating paddy with MTU 1001 variety using drill sown method. Famers practicing variety MTU-1001 having duration of 135-136 days during kharif season. Recommended paddy variety MGD-101 developed by University of Agricultural Sciences, Dharwad, Karnataka also having duration of 135 days. Paddy is being sown during June 2nd to 3rd week and facing problem of moisture stress due to early withdrawal of monsoon at panicle stage leading chaffyness and this causes low yield. Short duration Paddy variety Sahabagidhan is developed by CRRI, Cuttack having duration of 125-126 days during kharif season. Use of short duration variety can escape from moisture stress at panicle stage.

The general objectives of on farm trials is to conduct adoptive research in farmer's field of local regions condition. The localised adoptive research conducting for developing or fine tuning of technologies or varieties for localised problems. On farm trials can play important role to develop a particular technologies for particular local regions. In this regard, present study was conducted to assess different paddy varieties under rainfed situation in drill sown method in upland situation at different locations in Uttara Kannada district of Karnataka state. On farm trial focused on assessing alternate paddy short duration variety Sahabagidhan in comparison with recommended variety MGD-101 and farmers practice MTU-1001.

2. Material and Methods

The study was conducted by Krishi Vigyan Kendra, Sirsi (Uttara Kannada District), University of Agricultural Sciences, Dharwad, Karnataka, in the farmers field of adopted villages of Uttara Kannada district during Kharif season under rainfed situation for years of 2019-20 and 2020-21. On farm trials was conducted to assess different paddy varieties under rainfed situation in upland situation at different locations in Uttara Kannada district of Karnataka state. Technology options include alternate paddy short duration variety Sahabagidhan in comparison with recommended variety MGD-101 and farmers practice MTU-1001. The soil of the experimental site was sandy clay loam. The details regarding implementation of on farm trial are shown in Table 1. The details of cultivation practices followed in farmers field under on farm trials are presented in Table 2.

2.1 Land preparation

Main field was ploughed for two times and levelled followed by cultivator and brought soil to good tilth condition using summer rains. Dolomite lime was applied at time of passing cultivator 20 days before sowing to bring soil pH to normal range.

2.2 Sowing

Seeds were treated with fungicide Carbendazim at the rate 2 gram per kg of seed. Sowing of paddy seeds was done using bullock drawn drill at 10 inch spacing after receipt of kharif rain. Nutrients were supplied to the crop as per the package of practices along with seeds. Twenty five kilogram of Zinc sulphate per hectare was applied along with 250 kg of powder form of farm yard manure.

2.3 Observations recorded

2.3.1 Observations on Crop

Crop observations like plant height (cm), number of tillers per hill, panicle length (cm), number of grains/panicle, grain weight/ plant (g), grain yield (kg/ha) and straw yield (t/ha) were recorded at harvesting stage. The percentage increase in grain yield and straw yield in Sahabagidhan and MGD-1001 varieties over MTU-1001 variety were calculated.

2.3.2 Observation on Insect pest

Observations on damage potential of stem borer and leaf folder was observed in randomly selected five hills in five different places in an acre area and computed as per the formulae.

$$\text{Percent dead heart (Stem borer)} = \frac{\text{Number of dead hearts/hill}}{\text{Number of total tillers/hill}} \text{ x100}$$

$$\text{Percent leaf damage (Leaf folder)} = \frac{\text{Number of damaged leaves/hill}}{\text{Total number of leaves/hill}} \text{ x100}$$

Observations on Brown plant hopper (BPH) were recorded by counting population adult or nymph in randomly selected five hills and ear head bug were recorded by counting population infestation on panicle per hill. The percent control of all insect pest were calculated.

2.3.3 Observation on Diseases

The data regarding the occurrence of the diseases was collected before application of fungicides by using the disease rating scale of 0-9 developed by International Rice Research Institute (IRRI. 1996) and then converting into per cent disease by using the formula.

$$\text{Disease \%} = \frac{\text{Sum of the scores}}{\text{Number of observation x highest number in rating scale}} \text{ x 100}$$

2.3.4 Economics

The gross returns, net returns, cost of cultivation and B:C ratio were worked out based on the market rate. B:C ratio was calculated by dividing gross returns by cost of cultivation.

3. Result and Discussion

3.1 Effect of Paddy varieties on Growth and yield parameters of paddy.

In both years of on farm trials, the growth and yield parameters of paddy were influenced by varieties (Table 3). During kharif 2019, the higher plant height (78.9 cm), number of tillers/hill (8.4), Panicle length (21.8 cm), number grains/panicle (148.7) and grain weight /plant (3.15 g) were reported in Sahabagidhan variety. *Whereas*, MTU 1001 variety recorded lower number of tillers/hill (7.29), number grains/panicle (131.3), grain weight /plant (2.86 g). Grain yield (63.6 q/ha) and straw yield (6.6 t /ha) of paddy were also higher with Sahabagidhan variety (Table 3). *Whereas*, MTU-1001 had recorded lower grain yield of 50.1 q /ha and straw yield of 5.2 t/ha. There was increase of 26.95% in grain yield and 26.92% in straw yield over MTU-1001. Data recorded with MGD -101 variety was in between Sahabagidhan and MTU-1001 varieties. Similar data on growth and yield parameters was observed during kharif 2020 also. Two years pooled data also showed similar trend with respect to growth and yield parameters in Sahabagidhan variety as compared to MTU-1001 and MGD-101 (Table 3). The improvement in yield parameters of rice was due to growth parameters recorded with tested variety Sahabagidhan. Sahabagidhan variety being short duration of 125 days escaped from moisture stress at panicle stage hence, recorded higher grain and straw yield. *Whereas*, other two varieties MGD-101 and MTU-1001 had duration of 135-136 days and experienced moisture shortage at panicle stage and that caused lower yield of grain and straw. Kumar *et al.* (2015) revealed that significant yield decline was observed in all rice genotypes under water stress condition compared to irrigation condition. Out of these 12 rice genotypes, IR88964-24-2-1-4, IR 88966-43-1-1-4 and IR 88964- 11-2-2-3 showed superiority in terms of grain yield and yield attributes. Out of 25 genotypes tested, five genotypes *viz.*, Anna (R) 4, APO, Kuliyadichan, Kattanur and Sivappuchithiraikar recorded significantly high grain yield under water stress (Ambikabathy *et al.*, 2019) [1]

3.2 Effect of Paddy varieties on Insect pests incidence

The incidence of insect pest on paddy was influenced by the assessed paddy varieties in both years of study (Table 4). In the first year of study, incidence of stem borer (3.5%), BPH population (8.3 /hill) and ear head bug population (1.8 / hill) were less in Sahabagidhan paddy. *Whereas,* MTU-1001 and MGD-101 recorded higher incidence of stem borer (6.0 and 5.6 dead heart%, respectively) , Brown plant hoppers (BPH) population (10.2 and 9.8 /hill, respectively) and ear head bug population (4.8 and 2.2 /hill, respectively). Lower leaf folder incidence was reported in MGD-101 (20.0% leaf damage per hill) as compared to Sahabagidhan (22.0% leaf damage per hill) and MTU-1001 (22.0% leaf damage per hill). Similar results were obtained during second year study also. Pooled data indicated that incidence of stem borer (3.6%), BPH population (7.5 /hill) and ear head bug population (2.0 /hill) were less in Sahabagidhan paddy as compared to MTU -1001 and MGD-1001 paddy variety. MTU-1001 and MGD-101 recorded higher incidence of stem borer (5.5 and 5.3 dead heart%, respectively), Brown plant hoppers population (9.4 and 8.5 /hill, respectively) and ear head bug population (4.2 and 2.5 /hill, respectively). Lower leaf folder incidence was registered in MGD-1001 (20.0% leaf damage per hill) as compared to Sahabagidhan (21.0% leaf damage per hill) and MTU-1001 (23.5% leaf damage per hill) . The *per cent* control of stem borer , and Ear head bug were higher with Sahabagidhan paddy variety over MTU-1001 and MGD-101variety in both the years of study. The higher per cent control of leaf folder was reported with MGD-101 as compared to Sahabagidhan and MTU-1001 during both in kharif 2019 and 2020. Pooled data results indicated that *per cent* control of stem borer (34.6%), BPH (20.2%) and Ear head bug (52.4%) were higher with Sahabagidhan paddy variety over MTU-1001 variety. Whereas, Variety MGD 101 recorded higher *per cent* control of stem borer (3.6%), BPH (9.6%) and Ear head bug (40.5%) over MTU-1001. The Variety MGD 101- reported 14.9% control of leaf folder followed by Sahabagidhan (10.6% control) over MTU-1001. The higher per cent control of insect pest in assessed paddy variety Sahabagidhan might be due to inherent tolerance capacity of the variety. Plant resistance is an inherited characteristic of a host that lessens the attack of a pest, may it be the insect, disease, nematode or other organisms. Host plant resistance has the potential to be an alternative for effective, economic and ecofriendly means of pest management in rice independent of pesticide use. The resistance of rice plant to biotic stresses may be an inherited one (Resistant through donor) or it may be induced by application of an elicitor, activating the defence mechanism of the plant.

The BPH resistant selections, IR 26 and IR 1561-228-3, were grown widely in the Philippines during 1974 and 1975. Both cultivars have Bph1 gene for resistance. IR36 and IR38 which have the bph2 gene for resistance to BPH were released by the Philippine Government during 1976 (Fujita *et al*. 2013). Seven hundred and ten rice cultivars from NRRI that were valuated against YSB in 2007, resistant cultivars with score 1 (below 5% white ear head) were NDR 402, CR 580-5, LPR 256, LPR 85, LPR 14, LPR 96-10,LPR 56-49, LPR 50, Kariawa 4, TCA 12, Bazail 65, Nali Hazara, Janaki, OR 1358-RGA-4, OR 1529-28-2, TKM 6, ARC 10660, Litipiti, Daonara, Chadhei Nakhi, Dahijhil, Brahmanbojni, Mahalakshmi, Jogen, Punshi, Triveni and Saket-4 as against Jaya the susceptible check with score 9 (28.1% WEH) (Mayabini Jena *et al*., 2017) [7].

3.3 Effect of paddy varieties on diseases incidence

The different paddy variety had influence on disease incidence in paddy in both the years of study (Table 5). Sahabagidhan paddy variety recorded lesser incidence of blast (10.8%), grain discolouration (1.0%) and false smut (0%) during first year of study. Whereas, MTU-1001 and MGD-101 recorded higher incidence of blast (18.0 and 15.0%, respectively), grain discolouration (18.9 and 10.3%, , respectively) and false smut (6.0 and 5.5% , respectively). Similar trend was observed during second year study also. Two years pooled data (Table 5) indicated that Sahabagidhan paddy variety recorded higher blast incidence (9.3%), grain discolouration (1.3%) and false smut (0%). Whereas, MTU-1001 and MGD-101 recorded higher incidence of blast (19.0 and 15.0%, respectively), grain discolouration (20.7 and 11.5%, respectively) and false smut (7.0 and 6.0% , respectively). The per cent control of diseases were influenced by paddy varieties in both the years of study (Table 5). During first year of study, the per cent control of blast (40.0%) , and grain discolouration (94.7%) and false smut (100.0%) were higher with Sahabagidhan paddy variety over MTU-1001. Paddy variety MGD-101 reported per cent control of blast (16.7%) . grain discoloration (45.5%) and false smut (8.3%) over MTU – 1001. Similar results were obtained during second year also. Two years pooled data indicated that per cent control of blast (51.1%),grain discolouration (93.7%) and false smut (100.0%) were higher with Sahabagidhan paddy variety over MTU-1001 variety. Whereas, Variety MGD 101 recorded per cent control of blast (21.1%), grain discolouration (44.4%) and false smut (14.3%) over MTU-1001. The higher per cent control of disease in assessed paddy variety Sahabagidhan might be due to inherent tolerance capacity of the variety. Yang *et al*. (2017) screened 358 rice varieties for the presence of 13 major blast resistance (R) genes against *Magnaporthe oryzae* using functional markers out of which 259 varieties were having one to seven R genes. Twenty-six SSR markers associated with blast resistance in a set of 276 indica landraces from China and few from different parts of the world were reported. Genome wide association mapping (GWAS) identified 16 LAFBR and 20 resistant cultivars with seventy-four candidate genes, which encode receptor-like protein kinases, transcription factors, and other defence-related proteins (Zhu *et al*. 2016). The resistance of rice genotypes to false smut under natural disease incidence was reported by various workers. Out of the seven rice genotypes screened, IRAT 170 was highly resistant, Ex-China was resistant (disease severity score < 1% to false smut), ITA 316 was moderately resistant (disease severity score <5%). Genotype ITA 150 was susceptible, while ITA 315, ITA 335, and FARO 3 were highly susceptible with disease severity scores >20% (El-Shafey 2013) [2].

3.4 Effect of paddy varieties on economics of paddy cultivation

The economics of rice cultivation was influenced by paddy varieties (Table 6) in both the years. During kharif 2019, the higher gross income (Rs.1,08,600/ha), net income (Rs. 60350 /ha) and B:C ratio (2.25) were recorded in Sahabagidhan paddy variety followed by MGD-101 which has recorded gross returns (Rs.94180 /ha), net returns (Rs.45930 /ha) and B:C ratio (1.95). The lowest gross returns (Rs.90560 /ha), net

returns (Rs. 42310 /ha) and B:C ratio (1.88) with MTU-1001 paddy variety. During second year also followed similar trend in grass returns, net returns and B:C ratio. Two years pooled data indicated that, Sahabagidhan paddy variety recorded higher gross income (Rs. 106600 /ha), net income (Rs.57850 /ha) and B:C ratio (2.19) followed by MGD-101 which has recorded gross returns (Rs.91730 /ha), net returns (Rs.43430 /ha) and B:C ratio (1.89). The lowest gross returns (Rs.89555 /ha), net returns (Rs.41310 /ha) and B:C ratio (1.86) with MTU-1001 paddy variety. The cost of cultivation of paddy was not varied much among paddy varieties assessed. Increase in grass returns and net returns was due to higher grain and straw yield intern due to increased growth and yield parameters. Punit Tiwari *et al* (2018) [9] reported that PS-3 paddy variety proved its superiority by giving highest net income up to Rs. 49778/ha. However the second equally best variety was PS-5 giving net income up to Rs. 48652/ha. The third best variety was IR-64 nearby giving net income up to Rs. 39485/ha. This was followed by Danteshwari and then Vandana giving lowest net income up to Rs. 25504/ha which reduced by Rs. 24274/ha. The net income in related to the crop productivity and the gross income received.

Table 1: Details of the On Farm Trials

S. No	Particulars	Kharif 2019			Kharif 2020			Pooled Data		
		MTU-1001	MGD-1001	Sahabagidhan	MTU-1001	MGD-1001	Sahabagidhan	MTU-1001	MGD-1001	Sahabagidhan
1	Area under each trial	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
2	No. of farmers /trials	10	10	10	10	10	10	10	10	10
3	Total area of trials	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
4	Villages	Haraganahalli and Tippanageri			Haraganahalli and Tippanageri			Haraganahalli and Tippanageri		
5	Taluk	Mundgod and Haliyal			Mundgod and Haliyal			Mundgod and Haliyal		
6	Soil Type	Sandy clay loam			Sandy clay loam			Sandy clay loam		
7	Situation	Rainfed			Rainfed			Rainfed		
8	Date of sowing of Paddy	III week of June			II week of June			-		
9	Method of sowing	Bullock drawn Drill sowing			Bullock drawn Drill sowing			Bullock drawn Drill sowing		
10	Date of Harvest	12th to 14th, November 2019	11th to 13th, November 2019	31st October, 2019	29-30th October 2020	28-29th October 2020	18-19th October 2020	-	-	-

Table 2: Details of the cultivation practices adopted in on farm trials

S. No	Particulars	Kharif 2019	Kharif 2020
1	Seed rate (kg/ha)	62.5- 75.0	62.5
2	Lime Application	5.0 q/ha	5.0 q/ha
3	Farm Yard Manure	2.0-2.5 t/ha	2.5-2.8 t/ha
4	Zinc Sulphate application	10 kg/ha	10 kg/ha
5	Seed Treatment with Carbendazim	@ 2g/ Kg seeds	@ 2g/Kg seeds
6	Spacing	10 inch row spacing	10 inch row spacing
7	Fertilizer application	100:50:50 kg NPK/ha	100:50:50 kg NPK/ha
8	Blast management	Tricyclazole @ 0.8 g/l	Tricyclazole @ 0.8 g/l
9	Stem borer management	Chlorpyriphos @ 2 ml/l	Spray of Chlorpyriphos @ 2 ml/l
10	Leaf folder management	Chlorpyriphos @ 2 ml/l	Profenophos @ 2ml/l
11	BPH management	Imidacloprid @ 0.25 ml/l	Imidacloprid @ 0.25 ml/l
12	Ear head bug management	Neem oil @ 5 ml/l Malathion @ 2 ml/l	Neem oil @ 5 ml/l Malathion @ 2 ml/l

Table 3: Effect of varieties on growth and yield parameters of rice

Parameters	Kharif 2019			Kharif 2020			Pooled data		
	MTU-1001	MGD-101	Sahabagidhan	MTU-1001	MGD-101	Sahabagidhan	MTU-1001	MGD-101	Sahabagidhan
Plant Height (cm)	73.3	72.1	78.9	75.5	74.1	82.3	74.4	73.1	80.6
No. of Tillers	7.29	7.8	8.4	8.5	8.6	10.4	7.9	8.2	9.4
Panicle length (cm)	18.9	20.7	21.8	18.0	21.4	22.4	18.5	21.1	22.1
No. of Grains /panicle	131.3	136.8	148.7	130.2	134.2	146.5	130.8	135.5	147.6
Test weight (g/1000 grains)	21.8	22.4	21.5	22.2	23.4	22.6	22.0	22.9	22.1
Grain weight /plant (g)	2.86	3.05	3.15	2.78	3.00	3.02	2.82	3.03	3.03
Grain yield (q/ha)	50.1	52.5	63.6	48.1	49.5	60.3	49.1	51.0	61.95
% Increase in yield	-	4.79	26.95	-	2.91	25.36	-	3.85	26.16
Straw yield (t/ha)	5.2	5.09	6.6	5.3	5.2	5.88	5.25	5.15	6.24
% increase in straw yield	-	- 2.12	26.92	-	- 0.96	12.00	-	-1.54	19.46
Days to maturity	136	135	125.5	136	135	126	136	135	125.8

Table 4: Effect of varieties on incidence of insect pest in rice

Parameters	Kharif 2019			Kharif 2020			Pooled data		
	MTU-1001	MGD-101	Sahabagidhan	MTU-1001	MGD-101	Sahabagidhan	MTU-1001	MGD-101	Sahabagidhan
Stem borer incidence (% Dead heart)	6.0	5.6	3.5	5.0	5.0	3.6	5.5	5.3	3.6
% Control of Stem borer	-	6.7	41.7	-	0.0	28.0		3.6	34.6
Leaf folder Incidence (% Leaf damage /hill))	22.0	20.0	22.0	25.0	20.0	20.0	23.5	20.0	21.0
% Control of Leaf folder	-	9.1	0.0	-	20.0	20.0	-	14.9	10.6
BPH Population (Nymph/Adult /Hill)	10.2	9.8	8.3	8.5	7.2	6.6	9.4	8.5	7.5
% Control of BPH	-	3.9	18.6	-	15.3	22.3	-	9.6	20.2
Ear head bug population / hill	4.8	2.2	1.8	3.6	2.8	2.2	4.2	2.5	2.0
% Control of Ear head bug	-	54.2	62.5	-	22.2	38.9	-	40.5	52.4

Table 5: Effect of varieties on incidence of diseases in rice

Parameters	Kharif 2019			Kharif 2020			Pooled data		
	MTU-1001	MGD-101	Sahabagidhan	MTU-1001	MGD-101	Sahabagidhan	MTU-1001	MGD-101	Sahabagidhan
Blast disease incidence (%)	18.0	15.0	10.8	20.0	15.0	7.8	19.0	15.0	9.3
% Blast control	-	16.7	40.0	-	25.0	61.0	-	21.1	51.1
Grain discolouration (%)	18.9	10.3	1.0	22.5	12.7	1.5	20.7	11.5	1.3
% Control of grain discolouration	-	45.5	94.7	-	43.6	93.3	-	44.4	93.7
Smut disease Incidence (%)	6.0	5.5	0.0	8.0	6.5	0.0	7.0	6.0	0.0
% Reduction	-	8.3	100.0	-	18.8	100.0	-	14.3	100.0

Table 6: Effect of varieties on economics of rice cultivation

Parameters	Kharif 2019			Kharif 2020			Pooled data		
	MTU-1001	MGD-101	Sahabagidhan	MTU-1001	MGD-101	Sahabagidhan	MTU-1001	MGD-101	Sahabagidhan
Gross returns (Rs/ha)	90560	94180	108600	88550	89280	104600	89555	91730	106600
% Increase in gross returns	-	4.0	19.9	-	0.8	18.1	-	2.4	19.0
Cost of Cultivation (Rs/ha)	48250	48250	48250	48240	48350	49250	48245	48300	48750
Net returns (Rs/ha)	42310	45930	60350	40310	40930	55350	41310	43430	57850
% Increase in Net returns	-	8.6	42.6	-	1.5	37.3	-	5.1	40.0
B:C ratio	1.88	1.95	2.25	1.84	1.85	2.12	1.86	1.89	2.19

4. Concussion

From the study, it could be concluded that short duration paddy variety Sahabagidhan having duration of 125 days escaped from moisture stress at panicle stage and recorded higher grain yield and returns with higher B:C ratio.

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