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Effect of Sowing Method and Seeding Rate on Yield and Yield Components of Rainfed Rice (*Oryza sativa* L.) Varieties in Woliso, South-West Shoa Zone, Ethiopia

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Abstract: A field experiment was conducted on a farmer's field in Woliso District of Oromia Region to determine the effect of sowing method and seeding rate on growth, yield components and yield of rice varieties under rainfed conditions. Factorial combinations of three varieties (X-jigna, Gumera and Superica-1), two sowing methods (broadcast and row planting) and three seeding rates (75, 100 and 125 kg/ha) were laid out in Randomized Complete Block Design with three replications. Analysis of variance showed significantly higher difference among varieties for productive tillers, higher grain yield and total biomass. Significantly higher number of tillers at maturity and productive tillers/0.5m^2 as well as higher grain yield and total biomass/0.5m^2 were produced by Gumera. On the other hand, significantly greater grain yield/ha was produced by Gumera than that of Superica-1 and X-jigna. The effect of sowing method was non-significant on the growth parameters, yield and yield components of rice plants. Significantly greater grain yield/ha was obtained at seeding rate of 100kg/ha than 75 and 125 kg/ha. Hence, based on this experimentation, Gumera at seeding rate of 100kg/ha with broadcasting or row planting method recommended for Woliso areas.

Keywords: Variety, Seeding Rate, Sowing Method, Rainfed Rice, Yield

1. Introduction

Rice (Oryzasativa L.) is the world's third largest crop after maize and wheat. It is the staple food for more than half of the world population. Rice cultivation is the principal activity and source of income for about 100 million households and its demand will continue to expand due to population growth and increasing consumption patterns in different regions [FAO, 2004].

Evidences have indicated that cultivation of the crop in Ethiopia was first started at Fogera and Gambella plains in the early 1970's. Recently, rice is cultivated in Fogera plains, Pawe, the Northern part of Ethiopia and Gambella in Western part of Ethiopia on small scale [MoARD, 2005].

In South-West ShoaZone of Oromia Region, a vast area of land is waterlogged in summer especially during July and August. Hence, low infiltration and drainage problems hamper soil management and production of most arable crops. Therefore, the major crop production constraints in the area include water logging and low use of improved agricultural technologies.

In order to make the use of such huge area of potentially cultivable land, rice was introduced in the Zone in 1970's in Teji areas by Koreans. However, the adoption of the crop by the farming communities was impeded in Zone, as well as, across the Region due to poor recognition of the potential of the crop for the flooded and waterlogged areas, lack of know-how to produce the crop, the absence of sustained and intensified research and improved packages and practices for production.

Therefore, to harness the potential and develop optimal production packages, intensive studies need to be made on cultural practices of rice production in Woliso areas in particular and in the Oromia Region in general. Among key cultural practices, the determination of sowing method and seeding rate for rice varieties (X-jigna and Gumera, and

Superica-1) are required to be worked out on the priority basis.

Thus, the objectives of this study were to determine effect of sowing method and seeding rate on yield and yield components of rice varieties under rain-fed conditions, to determine the interacting effects of sowing method, seeding rate and variety on yield and yield components of rice in the target area and to suggest optimal production practices for relatively adapted rice variety (ies) in Woliso.

2. Materials and Methods

2.1. Description of the Study Area

The experiment was conducted on a farmer's field during the main rainy season at Goro in Woliso District of Oromia Region. Geographically, the experimental site is located at 8^0 21' N latitude and 37^o 47' E longitude and at an elevation of 1820 m.a.s.l. According to [NMA, 2006], the total rain fall during 2006 cropping season is 1344.9 mm. The major portion of the total annual rainfall received is between June and September. The total rainfall received between these months in the 2006 cropping season was 841.4 mm which was 62.5% of the total rainfall in the year. The average yearly minimum and maximum temperatures were 12.9°C and 25.0°C, respectively. The rain for the main growing season usually commences in the beginning of June and terminates in end-September. The soil of the experimental site was Vertisol.

2.2. Experimental Details

Factorial combinations of three rice varieties (X-jigna, Gumera and Superica-1), two sowing method (broadcast and row) and three seeding rates (75, 100 and 125 kg/ha) were laid out in a randomized complete block design (RCBD) with three replications.

Each plot received uniform doses of 69 kg N/ha and 20 kg P/ha using urea (46% N) and di-ammonium phosphate (18% N and 20% P) fertilizers**.** Nitrogen was applied in two equal splits, at planting and at panicle initiation stage; whereas full dose of P was applied at planting.

The gross plot size was 4 m x 2.5 m (10 m^2). Each plot accommodated 10 rows of 4 m length in row planted plots. The outer most rows or 0.25 m width at both sides of plots and 0.5 m length at both ends of plots were considered as borders. The second and third rows at one side of each plot or 0.5 m width were designated as sampling area and fourth row or 0.25 m width served as guard for sampling areas. The net plot size was 1.25 m x 3 m (constituting the remaining five rows of 3 m length in row planted plots) for determination of grain yield. The distance between plots and blocks was 0.5 m and 1 m apart, respectively.

2.3. Data Collection

At 90% physiological maturity, number of tillers (productive, non productive and total)/0.5 m^2 were counted using 0.5 m x 0.5 m quadrat from two random locations of the sampling area. Number of spikelets/panicle was determined from randomly sampled 20 panicles from each plot.

Thousand-grain weight was recorded by counting 1000 grains of representative seeds samples collected from each plot. It was also adjusted to 12% moisture content and weighed using an electronic balance. At physiological maturity, plants were hand harvested close to the ground level.

Grain yield/0.5 m^2 and above ground total biomass yield/0.5 m^2 were determinedusing 0.5 m x 0.5 m quadrat from two random locations of sampling area. Harvest index was determined as ratio of grains to above ground total biomass/0.5 m^2. Crop of entire net plot area was harvested to determine grain yield, straw yield and total biomass yield and converted to kg/ha basis. Grain yield was adjusted to 12% moisture content and straw yield/ha was determined after sun drying for 3 weeks to bring moisture content to near minimum level.

2.4. Statistical Analysis

All data were subjected to analysis of variance (ANOVA) to evaluate the effect of treatments and their interaction [Gomez and Gomez, 1984] by using MSTAT-C software program. Significant differences between and/or among treatments were carried out using LSD at 5%or 1% level of significance.

3. Results and Discussion

3.1. Yield Components

The yield components viz. number of panicles per unit area, number of spiklets per panicle, percentage of ripened grains per panicle and thousand grain weight were determined. Among yield components, productive tillers are very important because the final yield is mainly a function of the number of panicles bearing tillers per unit area and number of grains per panicle [Chatterjee and Maiti, 1985].

Number of tillers, productive and unproductive tillers/ 0.5 m^2at 90% maturity

The main effects of variety and seeding rate were significant (P≤0.01) in affecting the number of tillers, productive and unproductive tillers (Table 1). Gumera produced significantly greater number of tillers than X-jigna and Superica-. Furthermore, higher number of tillers was produced by variety X-jigna as compared to that of Superica-1. Varietal differences in number of tillers were also reported by [Wilson and McClung, 1998] and [Lafarge et al., 2004]. Significantly greater number of productive tillers was recorded in Gumera than X-jigna and Superica-1. X-jigna and Superica-1 produced statistically similar number of panices/0.5m^2. On the other hand, significantly higher number of unproductive tillers was observed on Gumera and X-jigna varieties. Gumera and X-jigna produced comparable unproductive tillers.

Regarding the seeding rate, seeding rate of 100 kg/ha was produced significantly higher number of tillers than at other two seeding rates. Furthermore, 75 and 125 kg/ha produced comparable number of tillers.

On the other hand, seeding rates of 100 and 125 kg/ha produced significantly greater number of productive tillers/0.5m^2 as compared to the lowest 75 kg/ha of seeding rate. At Seeding rates of 100 and 125 kg/ha the numbers of productive tillers/0.5m^2 were comparable with each other. On the contrary, higher number of unproductive tillers were recorded at seeding rates of 100 and 75 kg/ha than 125 kg/ha (Table 1). The number of unproductive tillers was significantly decreased at the highest seeding rate of 125 kg/ha as compared to the other seeding rates. Greater increase in the number of unproductive tillers at 75 and 100 kg/ha, whereas, the proportion of number of unproductive tillers to productive tillers/0.5m^2 was quite low at seeding rate of 125 kg/ha. As a result, 125 kg/ha seeding rate recorded greater number of productive tillers/0.5m^2. [Yamada, 1961] also showed that under dense planting, the growth of each plant decreases and the size of the plants and productive tillers become smaller. The more densely the rice plants, fewer are the number of stems or tillers and productive tillers per hill but their number increases per unit area. The interaction effects of variety x sowing method, variety x seeding rate were not significant to affect the number of tillers, productive and unproductive tillers/ 0.5 m^2 at 90% maturity of rice (Table 2).

Number of spikelets per panicle

The number of spikelets per panicle was significantly affected by the main effect of variety and seeding rate (Table 1). Significantly higher number of spikelets per panicle was produced by X-jigna than Superica-1 and Gumera. Furthermore, higher spikelets/panicle was produced by Superica-1 as compared to Gumera. Also difference in spikelet numbers between varieties was reported by [Shiratsuchil et al., 2004].

Regarding seeding rate, 75 and 100 Kg/ha significantly produced greater number of spikelets per panicle than 125 Kg/ha. On the other hand, 75 and 100 kg/ha showed statistically similar number of spikelets/panicle (Table 1). Similar to these results, [Balocket al., 2002] who reported that the increased plant spacing considerably resulted in vigorous plant growth and caused a significant increase in number of panicles per hill, grain yield per hill, filled grain per panicle and thousand grain weights. Furthermore, several other workers [Mosalemet al., 2000] in other crop reported that increasing seeding rates decreased the number of spikelets/panicle, spike length, number and weight of grains/spike in wheat. [Jaama, 1998] also reported that due to reduced spike length, fewer spikelets/spike and kernels/spikelet of triticale were observed with increased seeding rate or plant density.

On the other hand, main effect of sowing method showed non significant effect on number of spikeletes per panicle. Likewise, the interaction effects were not significant (Table 2).

Table 1. *Effect of variety, sowing method and seeding rate onnumber of tillers at 90% physiological maturity (NTM), number of productive tillers (NPT), number of unproductive tillers (NUT) and number of spikelets per panicle (NSP).*

Treatment	NTM/0.5m^2	NPT/0.5m^2	NUT/0.5m^2	NSP
Variety				
X-jigna	196.7	163.8	32.8	96.2
Gumera	283.3	247.9	35.2	72.6
Superica-1	172.9	151.2	21.7	79.8
$LSD_{0.05}$	13.76	13.29	3.90	5.43
Sowing method				
Broad cast	214.9	186.0	28.9	82.5
Row planting	220.4	189.3	30.9	83.2
$LSD_{0.05}$	NS	NS	NS	NS
Seed rate (Kg/ha)				
75	208.7	173.3	35.2	88.3
100	227.1	194.6	32.5	84.5
125	217.1	195.1	22.0	75.8
$LSD_{0.05}$	13.76	13.29	3.90	5.43
C. V.,%	9.29	10.41	19.20	9.63

NS: non significant

Table 2. *Analysis of variance for number of tillers at 90% physiological maturity, number of productive tillers, number of unproductive tillers andnumber of spikelets per panicle.*

		Mean squares			
Source of variation	df	NTM /0.5m^2	Number of productive tillers/ 0.5 m^2	Number of Unproductive tillers/0.5m^2	Number of spikelets/panicle
Replication	2	152.89 NS	420.02 NS	75.10NS	122.08 NS
Variety (V)	2	60757.72**	49706.46 **	937.17**	2632.55 **
Sowing method (SM)	1	411.13NS	153.35 NS	54.00NS	5.95 NS
VXMS	2	807.46NS	889.13 NS	3.50NS	144.85 NS
Seeding rate(S)	2	1525.06*	2789.24**	872.17**	742.68**
V X S	4	77.11NS	118.19 NS	16.92NS	149.17 NS
MS X S	2	34.57 NS	79.69 NS	10.50NS	51.55 NS
V X MS X S	4	272.57 NS	224.80NS	4.25NS	19.17 NS
Error	34	408.40	381.53	32.94	63.60

**,* = significant at 1% and 5% levels, respectively
NS = non significant
df = degree of freedom

There was significant variation in thousand grain weight among varieties (Table 1). Variety Superica-1 produced significantly greater thousand seed weight than X-jigna and Gumera. On the other hand, Gumera and X-jigna showed similar thousand grain weights (Table 3).

The main effect of sowing method had no significant effect on thousand grain weight. Broadcast and row planting sowing method showed comparable thousand grain weight. Similarly, the main effect of seeding rate was not significant in affecting thousand grain weights. But there was a decreasing trend in thousand grain weight as the seeding rate was increased from 75 to 125 kg/ha. In conformity with these results, [Jan *et al.,* 2000] who conducted an experiment on wheat reported that as the seeding rate was increased, the number of plants emerged per unit area also increased but thousand seed weight decreased. [Lockhart and Wiseman, 1988] also revealed that higher number of tillers reduced the number, size and weight of grains. Further, [Wen and Yang, 1991] reported higher thousand-grain weight by planting one seedling/hill than with four seedlings/ hill.

Grain yield per 0.5 m^2

Statistical analysis of data showed highly significant difference (P≤0.01) due to the main effect of variety on grain yield of rice/0.5m^2 (Table 3). Gumera produced significantly higher grain yield/0.5m^{2}than Superica -1 and X-jigna. Furthermore, Superica-1 yielded significantly higher grain yield/0.5m^2 than X-jigna. Varietal differences in grain yield were also reported by [Yoshida and Parao, 1972] and they indicated that a variety of different tillering capacity and of improved type, yielded better than of low tillering one. Furthermore, it was also supported by [Fukai, 2000]; [Balock *et al.,* 2002]; [Bughio *et al*., 2002]; [Reddy *et al*., 2004].

The main effect of seeding rate was significant (P≤0.05) in affecting the grain yield of rice crop and higher grain yield /0.5m^2 was obtained at the rate of 100 Kg/ha than 125 and 75 Kg/ha. Seeding rates of 75 and 125 kg/ha produced comparable grain yield /0.5m^2 (Table 4). [Balock *et al.*, 2002] indicated that wider spacing had linearly increasing effect on the performance of individual plants. The plants grown with wider spacing have more area of land around them to draw the nutrition and had more solar radiation to absorb for better photosynthetic process and hence performed better as individual plants. The reason for deviation in case of grain yield per plot is that the grain yield does not entirely depend on the performance of individual plant but also on the total number of plants per plot and yield contributing parameters within the plant.

The main effect of sowing method and the interaction effects of variety x sowing method, variety x seeding rate, sowing method x seeding rate and variety x sowing method x seeding rate were not significant to affect the grain yield of rice (Table 4).

Total biomass per 0.5 m^2

Total biomass was significantly (P≤0.01) affected by the main effect of variety only (Table 3). Gumera produced higher total biomass yieldthan X-jigna and Superica-. Such a high total biomass yield was obtained as a result of high capacity of tillering of the variety and vigorous growth of the tillers. Furthermore, X-jigna produced significantly higher total biomass than the Superica-1.

Main effects of sowing method and seeding rate as well as the interaction effect of variety x sowing method, variety x seeding rate, sowing method x seeding rate and variety x sowing method x seeding rate were not significant in affecting the total biomass yield of rice (Table 4).

Harvest index

Harvest index represents the ratio of the dry matter of harvested part of the crop (grain yield) to the total dry matter production [Marschener, 1995]. The main effect of variety significantly affected the harvest index/0.5m^2 (Table 3). Analysed data revealed that Gumera and Superica-1 had significantly higher harvest index (40.51%) and (39.5%) than X-jigna (30.30%). On the other hand, Gumera and Superica-1 exhibited comparable harvest index. Significant varietal differences in harvest index have also been reported by [Evans *et al*., 1984]; [Stapper and Fischer, 1990]; [Brain, 2005].

The main effect of sowing method resulted in non-significant variation in harvest index. Similarly, the main effect of seeding rate was not significant for harvest index/0.5m^2 and there was a trend of increasing harvest index as seeding rate increased from 75 to 100 kg/ha but at a seeding rate of 125 kg/ha, the harvest index was decreased. These findings are in agreement with results obtained by [Brain, 2005] who reported that the effect of seeding rate was not significant for harvest index. Further, [Zeng and Shannon, 2000] showed that at high density, carbohydrate supply was limited because of shading among plants and the competition between shoot growth and panicle growth. This resulted in the reduction in harvest index with the increases in seeding densities. The interaction effect of variety x sowing method, variety x seeding rate, sowing method x seeding rate and variety x sowing method x seeding rate were not significant to affect the grain yield of rice (Table 4).

Table 3. *Effect of variety, sowing method and seeding rate effects on thousand grain weight, grain yield, total biomass and harvest index.*

Treatment	**Thousand Grain weight(g)**	**Grain yield (g)/0.5m^2**	**Total biomass (g)/ 0.5m^2**	**Harvest index (%)**
Variety				
X-jigna	26.17	148.72	472.83	31.5
Gumera	25.94	240.89	555.33	43.4
Superica-1	32.06	180.39	428.06	42.1
$LSD_{0.05}$	0.22	17.44	43.10	1.43
Sowing method				
Broad cast	28.00	183.15	471.15	38.9
Row planting	28.11	196.85	500.33	39.3
$LSD_{0.05}$	NS	NS	NS	NS
Seeding rate (Kg/ha)				
75	28.11	184.61	480.06	38.5
100	28.10	203.50	510.00	39.9
125	27.94	181.89	468.61	38.8
$LSD_{0.05}$	NS	17.44	NS	NS
C. V.,%	1.21	13.93	13.05	5.71

NS: non significant

Table 4. *Analysis of variance for thousand grain weight, grain yield, total biomass, harvest index.*

Source of variation	df	Thousand Grain weight (g)	Grain yield g/0.5m^2	Total biomass g/0.5m^2	Harvest index (%)/0.5m^2
Replication	2	0.39NS	1927.72NS	8290.30NS	7.46NS
Variety (V)	2	216.22**	39473.17**	74006.46 **	553.35**
Sowing method (SM)	1	0.17 NS	2535.19 NS	11498.96NS	4.92NS
VXMS	2	0.22 NS	1764.13 NS	9800.35NS	1.43NS
Seeding rate(S)	2	0.17NS	2493.72*	7616.35NS	5.68NS
V X S	4	0.06 NS	806.64 NS	6463.35NS	1.20NS
MS X S	2	0.06 NS	1037.57NS	2135.91NS	0.03NS
V X MS X S	4	0.11 NS	179.94 NS	5018.80NS	0.03NS
Error	34	0.114	700.47	4017.00	4.40

**,* = significant at 1% and 5% levels, respectively
NS = non significant
df = degree of freedom

3.2. Yield

Grain yield per hectare

Grain yield was significantly (P≤0.01) affected by the main effects of variety and seeding rate (Table 5). Higher grain yield/ha was produced by Gumera than Superica-1 and X-jignaas it produced greater dry weight, number of tillers and productive tillers due to its higher tillering ability. Varietal differences for grain yield were also reported by [Fukai, 2000]; [Balock *et al.,* 2002]; [Bughio *et al*., 2002]; [Reddy *et al*., 2004].

On the other hand, at seeding rate of 100 kg/ha, significantly higher grain yield was obtained than at 75 and 125 kg/ha (Table 5). Furthermore, seeding rates of 75 and 125 kg/ha produced comparable grain yield/ha. At the seeding rate of 100 kg/ha, the grain yield/ha was increased by 506 kg/ha (22.2%) and 561 kg/ha (25.2%) as compared to 75 and 125 kg/ha, respectively. The present findings are not in agreement with that of [Sewunet, 2005] where higher grain yield was obtained at a seeding rate of 120 kg/ha than 60, 80 and 100 kg/ha seeding rates with X-jigna variety in Fogera areas, South Gonder of Amhara Region, Ethiopia.

Grain yield of rice increased with the increase in the number of plants per unit area as long as there is space in the cultivated areas. When planting density exceeds an optimum level, competition among plants for light above ground and for nutrients below ground becomes severe. Consequently, plant growth slow and grain yield decreases. Similar results were reported by [Zeng and Shannon, 2000] who reported that the reduction in fertility at high density was one of the causes for the reduction of seed yield per plant with the increase of seeding density.

The main effect of sowing method was not significant in influencing the grain yield of rice (Table 5). The present study is in agreement with results obtained by [Dhurandher *et al*., 2000] who reported that line sowing and broadcasting produced similar effect on productivity and profit of rice crop. [Klosterboer and Turner, 2002] also reported that there is no yield difference among the row drilled and broadcast seeding if the stands are adequate.

The interaction effects of variety x sowing method, variety x seeding rate, sowing method x seeding rate and variety x sowing method x seeding rate had no significant effect on grain yield of rice (Table 6).

Straw yield per hectare

Statistical analysis of data showed significant differences in straw yield due to the main effect of variety (Table 5). Maximum straw yield/ha was obtained in Gumera and X-jigna than Superica-1. Furthermore, X-jigna and Gumera showed statistically similar straw yield/ha.

The main effect of sowing method and seeding rate were not significant in influencing straw yield/ha of rice crop. Broadcast and row planting sowing method produced comparable straw yield/ha. On the other hand, there was a trend of increment in straw yield/ha as the seeding rate increased from 75 kg/ha to 100 kg/ha. But at the seeding rate of 125 kg/ha, the straw yield decreased which was less as compared to 75 kg/ha seeding rate. [Balock *et al.,* 2002] showed that straw yield increased with increased spacing in transplanted rice.

The interaction effects of variety x sowing method, variety x seeding rate, sowing method x seeding rate and variety x sowing method x seeding rate had no significant effect on straw yield/hectare (Table 6).

Total biomass yield per hectare

The main effect of variety was significant in affecting total biomass yield (Table 5). Gumera produced significantly (P≤0.01) higher total biomass than X-jigna and Superica-1. Furthermore, Superica 1 and X-jigna produced comparable total biomass yield.

The main effects of sowing method had non-significant effect on total biomass yield. Similarly, the main effect of seeding rate was non-significant in influencing variation on total biomass yield/ha. [Kanada and Kakizaki, 1957] observed a logarithmic relationship between plant population and production of total dry weight per unit area. [Yamada, 1961] reported that the total dry matter and grain weight per unit area increased with decrease in spacing up to a certain extent after which, there was no change or decrease depending on the character of the variety. This is in other way, implied that higher planting density within limit might produce more total dry matter per unit area. The interaction effects of variety x sowing method, variety x seeding rate, sowing method x seeding rate and variety x sowing method x seeding rate were not statistically significant effect in affecting total biomass yield per hectare of rice crop (Table 6).

Table 5. *Effect of variety, sowing method and seeding rate effects on grain, straw and total biomass yield (kg/ha).*

	Yield (kg/ha)		
Treatment	**Grain**	**Straw**	**Total biomass**
Variety			
X-jigna	1823	4359.00	6182.00
Gumera	3264	4450.44	7714.44
Superica-1	2200	3592.80	5792.80
$LSD_{0.05}$	265.7	384.0	652.30
Sowing method			
Broad cast	2329	4155.22	6484.22
Row planting	2529	4113.00	6642.00
$LSD_{0.05}$	NS	NS	NS
Seeding rate (Kg/ha)			
75	2279	4015.50	6294.50
100	2785	4055.50	6840.50
125	2224	3963.30	6187.30
$LSD_{0.05}$	265.7	NS	NS
C. V.,%	16.07	13.65	14.32

NS: not significant

Table 6. *Analysis of variance for grain yield, strawyield and total biomass yield.*

		Mean squares		
Source of variation	**df**	**Grain yield Kg/ha**	**Straw yield Kg/ha**	**Total biomass yield Kg/ha**
Replication	2	357258.30 NS	205092.13NS	1674997.85NS
Variety (V)	2	10049452.35 **	3992610.80 **	15472331.13 **
Sowing method (SM)	1	537802.24 NS	24108.91 NS	2379720.30NS
VXMS	2	6310.57 NS	989610.69 NS	2907965.57 NS
Seeding rate(S)	2	1719623.19**	414706.96NS	2090112.96NS
V X S	4	204844.10NS	231859.88NS	326947.44 NS
MS X S	2	660237.85 NS	391470.30NS	1027092.07NS
V X MS X S	4	85565.60 NS	72977.16 NS	209549.44 NS
Error	34	152322.81	318367.13	918431.28

**,* = significant at 1% and 5% levels, respectively
NS = non significant
df = degree of freedom

4. Conclusions

The study was conducted to determine the effect of sowing method and seeding rate on growth, yield and yield components of three rice varieties under rainfed conditions.

The results showed that significant differences in grain yield and most of parameters of rice were observed due to variety and seeding rates; especially in case of Gumera which yielded maximum yield at seeding rate of 100 kg/ha. On the other hand, sowing method had significant difference on crop phenology but had no effect on growth parameters, yield and yield components of rice crop under Woliso conditions. Hence, Gumera variety planted at a seeding rate of 100 kg/ha with either broadcasting or row planting method in Woliso area. But more information will be needed on more levels of individual factors, years and different production practices so that agronomic recommendations to the farmers can be generated on available cultivars for maximum production.

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