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Effect of recommended doses of fertilizer on growth and yield of wheat and mustard intercropping with citronella (*Cymbopogon winterianus*)

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Abstract

An experiment was conducted to study the effect of recommended doses of fertilizer on growth and yield of wheat and mustard intercropping with citronella (*Cymbopogon winterianus*)¹ was conducted during rabi season, 2015-16 at Students Instructional Farm (SIF), C.S. Azad University of Agriculture and Technology, Kanpur. The experiment was laid out in Randomized block design with 09 treatment of cropping systems with 03 fertility levels i.e. [Sole citronella, Sole Wheat, Sole Mustard, Citronella + Wheat (100%RDF), citronella + Wheat (75%RDF), citronella + Wheat (50%RDF), citronella + Mustard (100%RDF), citronella + Mustard (75%RDF), citronella + Mustard (50%RDF)], were replicated thrice. In case of citronella among the treatment maximum number of tiller per plant recorded in citronella + Mustard 100% RDF (40.33), whereas maximum herbage yield recorded in sole citronella (35.36 q/ha). In case of wheat maximum plant population (29.67 plant/m²), shoot length at harvest (107.67 cm), grain yield (34.63q/ha), straw yield (49.50q/ha), test weight (40.33g) was recorded in sole wheat, whereas fresh weight of shoot at 30 DAS (5.67g), shoot length at harvest (17.67cm), number of spikelet/spike (40) was recorded maximum in Citronella + Wheat (100%RDF). In case of mustard maximum initial plant population (7 plant/m²) was observed in Citronella + mustard (100%RDF), whereas plant height at 30 DAS (47.33 cm), plant height at 60 DAS (108.0 cm), number of branches per plant (8.0), number of silique per plant (186.0), biological yield (57.72q/ha) and harvest index (24.09) was recorded maximum in sole mustard.

Keywords: citronella, inter-cropping, wheat, mustard, growth and yield

Introduction

Citronella is an aromatic crop belonging to Poaceae (earlier Gramineae) family under genus *Cymbopogon*. Citronella grows to about 2 meter height having magenta colored base stems. Citronella plant looks like lemongrass but only a trained eye can make out the difference. *Cymbopogon winterianus* and *Cymbopogon nardus* are two main species of citronella, these species are used for production of citronella oil, which is used in scented soaps, deodorant, detergents, insect repellent, polishes and in aromatherapy etc. The main constituents of citronella, is geraniol and citronellol. Citronella oil is classified in trade into two types i.e. Ceylon citronella obtained from *Cymbopogon nardus* is the inferior type, while java citronella oil obtained from *Cymbopogon winterianus* considered superior type. In the country, herbal based drug industry in the country is valued of more than 4000 crore annually. India is a leader in the production of a variety of essential oils. Wheat (*Triticum aestivum* L.) is the most world widely cultivated food grain crop among the cereals which provides more than 50 percent calories to the people who mainly depend on it and is the principle food crop in most area of the world and will continue to be the major player in the Indian food sector. Wheat is the most important food crop of the world. Globally, it is grown in 122 countries which occupies approximately an area of 220 million hectares worldwide with production of 735.23 million tonnes (USDA, 2016), [2] it the second most produced cereal after maize in world. India accounts for about 8.7% of the total wheat production in the world, and 13% of all cultivated land. Wheat is most important winter crop grown all over India except Kerala during rabi season in area of 29.80 million hectares and production of 92.29 million tonnes with productivity of 3070 kg/ha and remarked to second wheat growing country after China (Economic survey 2015-16) [1]. It is consume mostly in form of bread as "Chapati" and "Straw" is used for feeding cattle. It is globally important source of dietary carbohydrate (starch) and protein (gluten). Mustard (*Brassica juncea*) is an annual oilseed crop belongs to family

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cruciferae. Rapeseed and Mustard are the rabi oilseed crops of India. They occupy a prominent place being next in importance to groundnut, both in area and production. India is one of the largest producers of rapeseed and mustard in the world. The area of rapeseed and mustard in India is 5.80 million hectare and production is around 6.30 million tonne and productivity 1089 kg/ha (Economic survey, 2015-16) [1]. The oil obtained from the different types show slight variation in percentage of oil. The oil content varies from 37 to 49%. The seeds and oil are used as condiment in the preparation of pickles and for flavoring curries and vegetables. The oil is utilized for human consumption throughout northern India for cooking and frying purposes. It is also used in the preparation of hair oil and medicines. Intercropping is a technique to increase yield, income of farm and risk management by best utilization of resources. For seeking feasibility of intercropping, crop like wheat, mustard and pulses etc. can be introduced as inter crop with citronella these crop combinations can be proved to seek risk coverage under present changing climatic scenario (Srivastava *et al.* 2016) [14]. The results indicated that different cropping system was found to exhibit significantly variations for growth and yield of citronella, wheat and mustard. The present experiment was carried out with an object to find out the effect of recommended doses of fertilizer on growth and yield of wheat and mustard intercropping with citronella (*Cymbopogon winterianus*).

Materials and Methods

An experiment was conducted during rabi season, 2015-16 at Students Instructional Farm (SIF), C.S. Azad University of Agriculture and Technology, Kanpur to study the "Effect of recommended doses of fertilizer on growth and yield of wheat and mustard intercropping with citronella (*Cymbopogon winterianus*). The experiment was laid out in Randomized block design with 9 treatment of cropping systems with 3 fertility levels i.e. [Sole citronella, Sole Wheat, Sole Mustard, Citronella + Wheat (100%RDF), citronella + Wheat (75%RDF), citronella + Wheat (50%RDF), citronella + Mustard (100%RDF), citronella + Mustard (75%RDF), citronella + Mustard (50%RDF)], were replicated in three time. In case of citronella fertilizer i.e. NPK should be applied @ 150:80:40 kg/ha for 100% RDF, 112.5:60:30 kg/ha for 75% RDF and 75:40:20 for 50% RDF. In case of wheat application of NPK @ 120:60:40 kg/ha for 100% RDF, 90:45:30 kg/ha for 75% RDF and 60:30:20 kg/ha for 50% RDF. In mustard fertilizer i.e. NPK should be applied at the rate 80:40:40 kg/ha for 100% RDF, 60:30:30 kg/ha for 75% RDF and 40:20:20 kg/ha for 50% RDF. The soil of experimental field was sandy loam, slightly alkaline in nature with 8.09 pH and 0.22 EC. The soil is low in organic carbon and available nitrogen (260 kg/ha), medium in available phosphorus (17.55kg/ha) and potash (175 kg/ha). Root slips of Citronella variety BIO-13 were used for transplanting. After removing upper sheath the root slips was transplanted in line on 30 July, 2010 at a spacing of 60 × 60 cm. The row ratio of 2:2 were maintained in citronella intercrop plots. Seed of Wheat cv. K-9107 (Deva) was used @ 100 kg/ha. The crop was sown with the help of Desi plough in line at a spacing of 20 cm row to row. Seed of Mustard cv. Urvashi was used @ 5 kg/ha. The crop was sown with the help of Desi plough at a spacing of 40 cm from row to row and 15 cm from plant to plant. For determining the significance of difference caused by different treatments data were subjected to statistical analysis by using ANOVA.

Result and Discussion

Effect of different treatments on number of tillers/plant in citronella at harvest stage and herbage yield (q/ha)

Data regarding number of tillers and herb yield of citronella, presented in Table 1 and Graph 1, showed there was non-significant difference in number of tillers/plant recorded, but numerically highest number of tiller/plant was recorded in citronella sole (40.33). Such types of observation were also observed by Srivastava *et al.* (2016) [14] and Ansari *et al.* (2015) [3]. Whereas herbage yield of citronella showed that the significantly highest herbage yield (35.36 q/ha) was observed in citronella sole treatment which were superior over all other treatments. The results are in close conformity with the findings of Ansari *et al.* (2015) [3] and Mani Ram *et al.* (2014) [7].

Effect of different treatments on growth, yield attributes and yield of wheat

Data regarding to growth, yield attributes and yield of wheat depicted in Table 2 and Graph 2 found that there was significant difference was observed for plant population, shoot length at harvest, fresh weight of shoot at 30 DAS, shoot length at harvest, number of spikelet/spike and grain yield of wheat, whereas non-significant difference was observed among the treatments for straw yield of wheat. The maximum plant population (29.67 plant/m²), shoot length at harvest (107.67 cm), grain yield and (34.63q/ha), straw yield (49.50q/ha), test weight (40.33g) was recorded in sole wheat. Maximum grain yield and straw yield recorded in wheat sole treatment over all the intercropping system may be due to more number of plant population and number of tillers in sole wheat crops and lack of competition among the plants. Similar finding was reported by Mali *et al.* (2015) [6], Deswal *et al.* (2013) [5], Sandal *et al.* (2013) [10], Shah and Ahmed (2006) [11]. Fresh weight of shoot at 30 DAS (5.67g), shoot length at harvest (17.67cm), number of spikelet/spike (40) was recorded maximum in Citronella + Wheat (100%RDF) it may be due to higher uptake of nutrient in intercropping system. The similar finding also reported by Pandey *et al.* (1999) [8] and Chaudhary *et al.* (2014) [4].

Effect of different treatments on growth, yield attributes and yield of mustard

Data regarding growth, yield attributes and yield of mustard, presented in Table 3 and Graph 3. It is clear from the table that there was significant difference among the treatments for plant height at 30 DAS, plant height at 60 DAS, number of siliques per plant and biological yield of mustard whereas data on plant population/m², number of branches per plant and harvest index was found to be non-significant among the treatments. Maximum initial plant population (7 plant/m²) was observed in Citronella + mustard (100%RDF). The similar finding also reported by Srivastava *et al.* (2007) [15], whereas plant height at 30 DAS (47.33 cm), plant height at 60 DAS (108.0 cm), number of branches per plant (8.0), number of siliques per plant (186.0), biological yield (57.72q/ha) and harvest index (24.09) was recorded maximum in sole mustard. The number of branches/plant depends on presence of competition between main crop and intercrops for growth resources such as nutrient, moisture and solar radiation because of exhaustive nature of main crop. The similar finding proposed by Singh *et al.* (2014) [13] and Sharma *et al.* (2015) [12]. Significantly the maximum biological yield Mustard sole treatment over other treatments it might be due to highest plant population in sole and number of siliques in

sole Mustard crops. The similar finding proposed by Pradhan *et al.* (2016)^[9] and Sharma *et al.* (2015)^[12].

Table 1: Effect of different treatments on Number of tillers/plant in Citronella at harvest stage and herbage yield (q/ha)

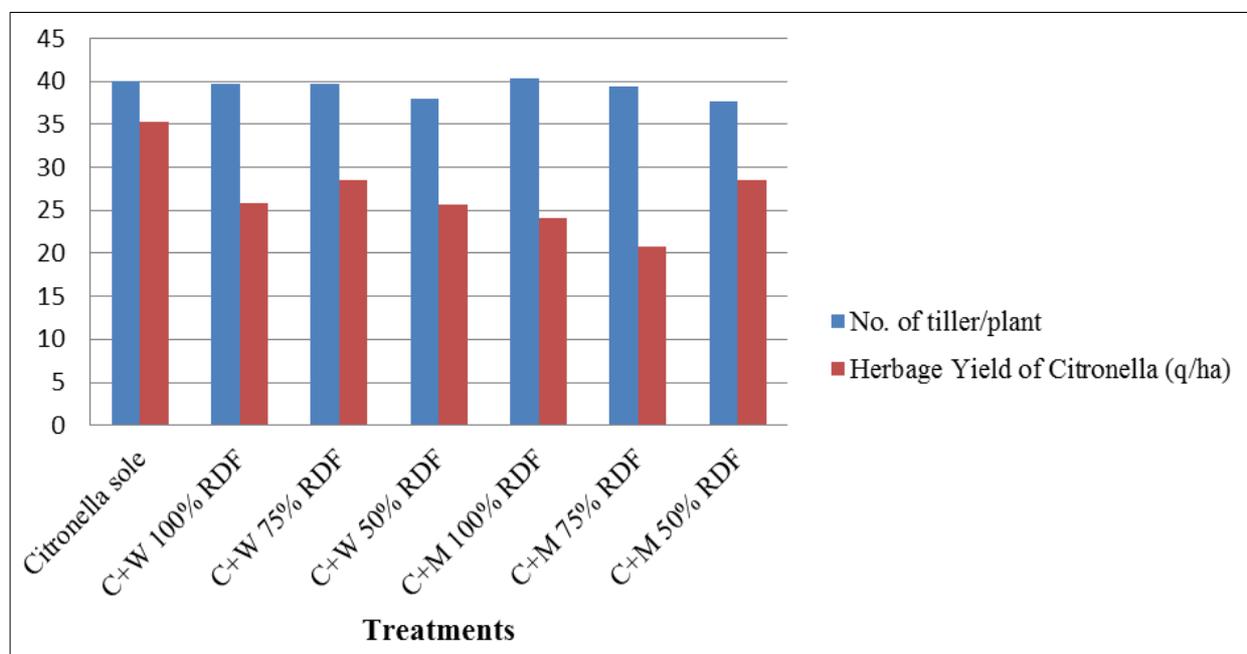
Treatment	No. of tiller/plant	Herbage Yield of Citronella (q/ha)
Citronella sole	40.00	35.36
C+W 100% RDF	39.67	25.87
C+W 75% RDF	39.67	28.46
C+W 50% RDF	38.00	25.61
C+M 100% RDF	40.33	24.15
C+M 75% RDF	39.33	20.70
C+M 50% RDF	37.67	28.46
SE(m)±	0.84	1.70
CD (5%)	NS	5.20

Table 2: Effect of different treatments on growth, yield attributes and yield of wheat

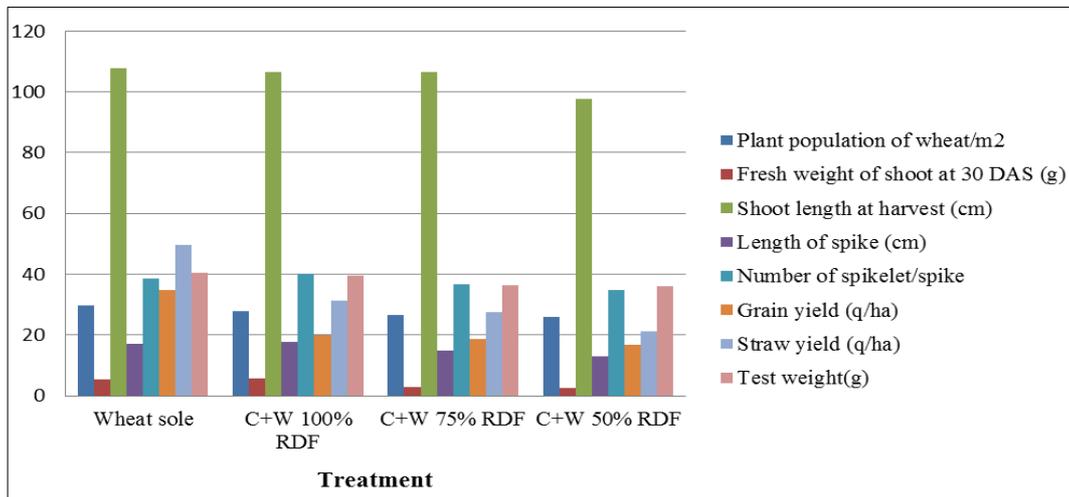
Treatment	Plant population of wheat/m ²	Fresh weight of shoot at 30 DAS (g)	Shoot length at harvest (cm)	Length of spike (cm)	Number of spikelet/spike	Grain yield (q/ha)	Straw yield (q/ha)	Test weight(g)
Wheat sole	29.67	5.33	107.67	17.00	38.67	34.63	49.50	40.33
C+W 100% RDF	27.67	5.67	106.67	17.67	40.00	19.90	31.33	39.67
C+W 75% RDF	26.67	3.00	106.68	15.00	36.67	18.63	27.54	36.33
C+W 50% RDF	26.00	2.67	97.67	13.00	34.67	16.82	21.11	36.00
SE(m)±	0.65	0.32	0.67	0.47	1.014	1.24	6.09	0.46
CD (5%)	2.28	1.13	2.35	1.66	3.57	4.38	NS	1.63

Table 3: Effect of different treatments on growth, yield attributes and yield of mustard

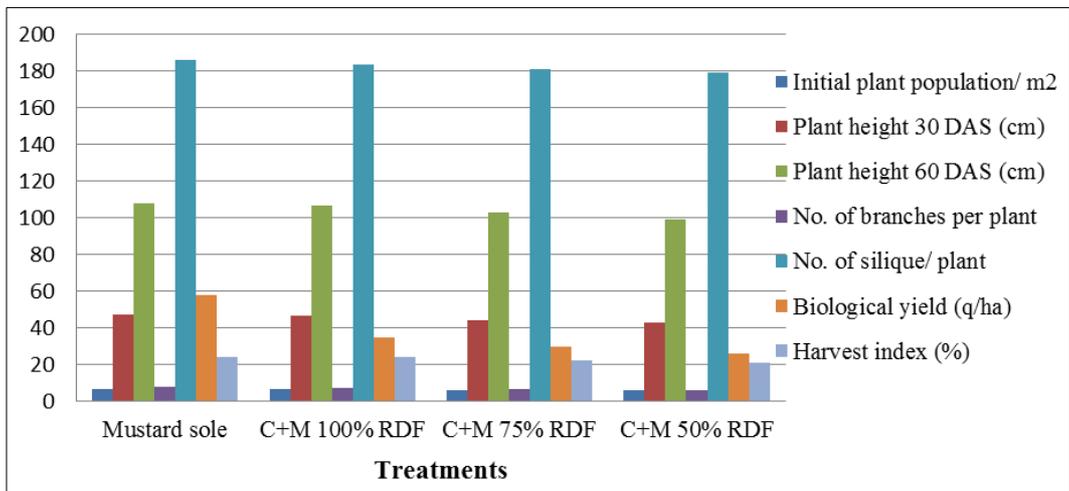
Treatment	Initial plant population/ m ²	Plant height		No. of branches per plant	No. of silique/ plant	Biological yield (q/ha)	Harvest index (%)
		30 DAS (cm)	60 DAS (cm)				
Mustard sole	6.67	47.33	108.00	8.00	186.00	57.72	24.09
C+M 100% RDF	7.00	46.67	106.67	7.33	183.67	34.63	23.97
C+M 75% RDF	6.00	44.33	103.00	6.67	181.00	29.68	22.60
C+M 50% RDF	6.33	42.67	99.00	6.33	179.33	26.38	20.97
SE (m)±	0.39	0.37	0.57	0.43	0.461	2.17	4.85
CD (5%)	NS	1.24	2.04	NS	1.63	7.65	NS



Graph 1: Effect of different treatments on Number of tillers/plant in Citronella at harvest stage and herbage yield (q/ha)



Graph 2: Effect of different treatments on growth, yield attributes and yield of wheat



Graph 3: Effect of different treatments on growth, yield attributes and yield of mustard

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