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Akshay Glotra
Research Scholar at NDRI,
Karnal, Haryana, India

Maneesha
Research Scholar at NDRI,
Karnal, Haryana, India

Magan Singh
Senior Scientist at NDRI,
Karnal, Haryana, India

Effect of nutrient management on the growth and yield of the fodder oats and Chinese cabbage in intercropping

Akshay Glotra, Maneesha and Magan Singh

Abstract

A field experiment consisting of seven treatments (Oats sole + RDF, Chinese Cabbage sole + RDF, Oats + Chinese Cabbage (1:1) + RDF, Oats + Chinese Cabbage (2:1) + RDF, Oats + Chinese Cabbage (1:2) + RDF, Oats + Chinese Cabbage (2:1) + 75% RDF+ FYM+ PGPR, Oats + Chinese Cabbage (1:2) + 75% RDF + FYM+ PGPR) was conducted during rabi season, 2020 to study the effect of nutrient management on the growth and yield of the fodder oats and chinese cabbage in intercropping. The experiment was laid out in Randomized Block Design with three replications. The growth parameters of oats like plant height, number of leaves per tiller and leaf length were recorded highest in "Oats + Chinese cabbage (2:1) + 75% RDF + FYM +PGPR". Total green and dry fodder yield were also recorded highest in the "Oats + Chinese cabbage (2:1) + 75% RDF + FYM +PGPR".

Keywords: Oats, Chinese cabbage, intercropping, nutrient management, yield

Introduction

Agriculture and its allied sectors are the backbone of Indian Economy. At present, India inhabits a livestock population of 538.8 million. Out of the above-mentioned number, cattle have a count of 192.49 million, buffalo represent a total of 109.85 million, sheep accounts for 74.26 million and a total of 148.88 million goats. The total area under fodder is 8.4 million hectares which is constant since last two decades. India is presently facing a net deficit of 35% green fodder and 11% dry fodder (Anonymous, 2013) ^[1]. Therefore, there is sharp need of the increasing fodder production. Intensification can help in this aspect and intercropping may be a simple and easy way for space intensification. Oats (*Avena sativa* L.) belongs to family Poaceae, is an important annual rabi crop in India, and is known as Jai or Javi in Indian Subcontinent. Nutritive value of Oats forage is high and showed to have dry matter digestibility in excess of 75% when fed to dairy cattle (Burgess *et al.*, 1972) ^[2]. Chinese cabbage also known as Pak choi, Bok choi (*Brassica rapa chinensis*) is one of major plant of cruciferae family. Chinese cabbage can be used in both ways as vegetable and as well as for the fodder purpose. Chinese cabbage is famous in the China and South East Asia. It is similar to mustard in appearance but its leaves are smoother than the mustard which makes it more palatable to the livestock. Jedel and Helm (1993) ^[3] found intercropping of Oats with pulse crop produced greater DM yield. Ross *et al.* (2004) ^[4] found that the intercropping of Oats and Berseem produced 21-25% greater yield than the sole cropping. This experiment was undertaken to study the performance of this intercropping and to maximise the yield potential of this intercropping by proper nutrient management.

Material and Methods

The experiment was conducted at Agronomy research farm, National Dairy Research Institute, Karnal located at 29°45' N, 76°58' E and at an altitude of 245 m above mean sea level of 245 m above mean sea level in the north western zone of Haryana. Experiment was laid out in the randomised complete block design consisting of seven treatments (Oats sole + RDF, Chinese Cabbage sole + RDF, Oats + Chinese Cabbage (1:1) + RDF, Oats + Chinese Cabbage (2:1) + RDF, Oats + Chinese Cabbage (1:2) + RDF, Oats + Chinese Cabbage (2:1) + 75% RDF+ FYM+ PGPR, Oats + Chinese Cabbage (1:2) + 75% RDF + FYM+ PGPR) and three replications. Fertilizers were applied according to the chinese cabbage requirement in intercropping treatment. Crops were raised as per the recommended package of practices and three readings were recorded respectively at 30, 45 DAS and at harvesting.

Corresponding Author:
Akshay Glotra
Research Scholar at NDRI,
Karnal, Haryana, India

Both the crops were harvested at 62 DAS and no further subsequent cuts were taken.

Results and Discussions

Growth Parameters

Plant Height

Oats gained maximum height in the ratio of intercropping 2:1 but only with the use of PGPR i.e., in treatment Oats + CC (2:1) + 75% FYM + PGPR which was at par with sole oats treatment i.e., Sole oats +RDF, but chinese cabbage obtained maximum height in the treatment of intercropping of two rows of chinese cabbage with one row of oat with the use of PGPR i.e., Oats + CC (1:2) + 75% RDF + FYM + PGPR which was at par with the sole treatment of chinese cabbage i.e., Sole CC + RDF. The lowest plant height for oat was obtained in the T₅ (Oats + CC (1:2) + RDF) at 30 DAS. Lowest height of chinese cabbage was obtained in the treatment T₆ at 30 DAS. Suri and Puri (1997) [5] at Palampur observed that 4:2 ratio of wheat and raya as compared to 4:1 exerted relatively higher depression in growth and development of wheat.

Number of tillers/branches per plant

The maximum number of tillers in oat/plant were obtained in its sole treatment (4.44) i.e., Sole oats + RDF which was significantly higher than intercropping treatment of Oats + CC (1:2) +RDF and was at par with all other treatments. Maximum number of branches in chinese cabbage were obtained in its intercropping treatment (9.50) but with the use of PGPR i.e., Oats+ CC (1:2) + 75%RDF + FYM + PGPR which was significantly higher than the treatment of Oats+ CC (1:1) +RDF and Oats+ CC (2:1) +RDF and was at par with all other treatments. Mandal *et al.* (1991) [6] also confirmed that the treatments involving wheat, mustard and

chickpea grown alone, or wheat in combination with mustard and chickpea affected branching and plant height in mustard and chickpea.

Number of Leaves tiller⁻¹/ Total number of leaves

Highest total number of leaves per tiller in oat crop was obtained in the intercropping of 2:1 with the chinese cabbage but with the use of PGPR i.e., in the treatment (Oats+ CC (2:1) + 75% FYM + PGPR) and in case of chinese cabbage the highest number of leaves were reported in its sole Chinese cabbage treatment i.e., Sole CC + RDF) which was at par with all other treatments at harvesting.

Leaf length

Highest leaf length in the oat crop was obtained in the intercropping of oats with the chinese cabbage in 2:1 with the use of PGPR i.e., in treatment of Oats + Chinese cabbage (2:1) +75% RDF + FYM + PGPR which was significantly higher than the T₅ i.e., Oats + CC (1:2) + RDF. The highest leaf length in the chinese cabbage crop was obtained in sole treatment i.e., in Sole CC+ RDF which was significantly higher than the intercropping treatment of Oats + CC (2:1) + RDF and Oats + CC (1:1) + RDF at harvesting stage.

Plant girth of main stem in chinese cabbage/ Girth of tiller of oat plant

Highest tiller girth in the oat plants were obtained in its sole treatment i.e., sole oats + RDF which was significantly higher than its intercropping treatment with chinese cabbage in the ratio of 1:2 i.e., Oats + CC (1:2) + RDF. But in case of chinese cabbage the highest plant girth was obtained in its sole treatment i.e., sole planting of the chinese cabbage after 30, 45 DAS and at harvest which was statistically at par with Oats + CC (1:2) + RDF at harvesting.

Table 1: Effect of Nutrient management on the Plant height and number of tillers/ branches per plant in oats and chinese cabbage intercropping

Treatment	Oats height (cm)			Chinese Cabbage height (cm)			Number of tillers plant ⁻¹ in oats			Primary branches
	30 DAS	45 DAS	At harvest	30 DAS	45 DAS	At harvest	30 DAS	45 DAS	At harvest	At harvest
T ₁ (Sole Oats + RDF)	45.23	75.82	130.16				4.44	7.28	8.17	
T ₂ (Sole CC + RDF)				39.64	64.68	147.00	-	-	-	9.45
T ₃ (Oats + CC (1:1) + RDF)	37.67	72.64	129.50	36.86	63.73	148.89	4.33	7.25	8.14	9.34
T ₄ (Oats + CC (2:1) + RDF)	40.13	67.06	124.31	36.08	63.13	145.26	4.11	7.25	8.15	9.31
T ₅ (Oats + CC (1:2) + RDF)	36.72	73.44	125.97	38.56	64.04	148.89	3.75	7.10	7.87	9.43
T ₆ (Oats + CC (2:1) +75% RDF + FYM + PGPR)	46.28	75.96	132.83	35.42	64.79	145.50	4.24	7.24	8.10	9.40
T ₇ (Oats + CC (1:2) +75% RDF + FYM + PGPR)	45.56	73.44	130.97	40.07	66.95	150.34	4.16	7.16	7.90	9.50
S.Em	0.44	1.05	0.86	1.09	2.24	1.30	0.16	0.02	0.03	0.04
CD (P=0.05)	1.40	3.30	2.72	3.57	7.06	4.09	0.51	0.06	0.10	0.14

Table 2: Effect of Nutrient management on the number of leaves tiller plant⁻¹ in oat and total number of leaves in chinese cabbage and leaf length in oats and chinese cabbage in intercropping

Treatment	Number of leaves tiller ⁻¹ in oat			Total number of leaves in chinese cabbage			Leaf length of oats(cm)			Leaf length of CC (cm)		
	30 DAS	45 DAS	At harvest	30 DAS	45 DAS	At harvest	30 DAS	45 DAS	At harvest	30 DAS	45 DAS	At harvest
T ₁ (Sole Oats + RDF)	5.11	5.47	5.74				31.58	44.56	53.30			
T ₂ (Sole CC + RDF)				7.13	11.81	15.10		-		22.94	24.76	28.66
T ₃ (Oats + CC (1:1) + RDF)	5.10	5.42	5.67	6.81	11.68	14.98	30.79	43.07	53.90	22.94	24.67	27.83
T ₄ (Oats + CC (2:1) + RDF)	4.86	5.46	5.76	7.11	10.67	15.05	30.79	43.98	53.83	21.13	24.27	28.23
T ₅ (Oats + CC (1:2) + RDF)	4.93	5.36	5.67	6.86	10.60	14.98	30.73	42.94	51.74	22.64	24.63	28.33
T ₆ (Oats + CC (2:1) +75% RDF + FYM + PGPR)	5.20	5.50	5.84	6.82	10.56	14.96	32.47	44.63	53.97	18.08	24.76	27.80

T ₇ (Oats + CC (1:2) +75% RDF + FYM + PGPR)	4.86	5.41	5.76	7.00	10.64	15.06	32.00	42.93	51.59	22.65	24.60	28.33
CD (P =0.05)	0.23	0.17	0.17	0.32	0.51	0.22	1.43	2.07	1.56	1.07	0.60	0.48

Table 3: Effect of nutrient management on the tiller girth and girth of chinese cabbage in oats and chinese cabbage in intercropping

Treatment	Oats tiller girth (in mm)			Chinese cabbage (in mm)		
	30 DAS	45 DAS	At harvest	30 DAS	45 DAS	At harvest
T ₁ (Sole Oats + RDF)	3.97	4.63	4.90			
T ₂ (Sole CC + RDF)		-		10.95	16.05	17.92
T ₃ (Oats + CC (1:1) + RDF)	3.57	4.31	4.83	10.56	15.11	17.44
T ₄ (Oats + CC (2:1) + RDF)	3.43	4.50	4.84	10.46	15.04	17.49
T ₅ (Oats + CC (1:2) + RDF)	3.25	4.23	4.77	10.60	15.44	17.74
T ₆ (Oats + CC (2:1) + 75% RDF + FYM + PGPR)	3.71	4.47	4.81	10.30	14.75	17.41
T ₇ (Oats + CC (1:2) + 75% RDF + FYM + PGPR)	3.63	4.29	4.81	10.87	14.73	17.84
S.Em	0.16	0.08	0.03	0.11	0.19	0.10
CD (P =0.05)	0.52	0.26	-	0.35	0.61	0.30

Green and Dry fodder yield (t/ha)

Green fodder yield is an important parameter to decide the potentiality and the outcome of the experiment. It is one of the most important parameters to determine the efficiency of the experiment. Highest green fodder yield of oat was obtained in its sole treatment (Sole oats + RDF) (45.37 t ha⁻¹) followed by the treatment of Oats + CC (2:1) + RDF (25.12 t ha⁻¹). The yield of treatment Oats + CC (2:1) + RDF was at par with the treatment T₆ (Oats+ CC (2:1) + 75% RDF + FYM + PGPR). Highest green fodder yield of chinese cabbage was obtained in its sole treatment i.e., Sole CC + RDF and was equal to the 54.86 t/ha followed by T₅(Oats + CC (1:2) + RDF) i.e., 47.03 t/ha. The highest green fodder yield of oats and chinese cabbage in respective green sole treatments were due to the highest

plant population of these crop plants in these treatments. Similarly dry fodder yield of the oats was highest in the sole cropping i.e, Sole oats + RDF that was significantly higher than the other treatments. Similar results were observed by Mandal *et al.* (1991) [6] in which he confirmed that the leaf area index and dry matter accumulation in sole wheat was significantly higher than the wheat + mustard intercropping in 4:2 ratio. Highest dry matter yield of chinese cabbage crop was highest in the treatment T₂ (Sole CC + RDF) which was significantly higher than the other treatments. Total highest dry matter yield was obtained in the treatment Oats + CC (2:1) +75% RDF + FYM + PGPR followed by the treatment Oats + CC (1:2) +100% RDF.

Table 4: Green and Dry fodder yield (t/ha)

Treatment	Green fodder Yield			Dry Fodder yield		
	Oat yield (t ha ⁻¹)	Chinese cabbage yield (t ha ⁻¹)	Total yield (t ha ⁻¹)	Oat (t ha ⁻¹)	Chinese cabbage (t ha ⁻¹)	Total yield (t ha ⁻¹)
T ₁ (Sole Oats + RDF)	45.37		45.37	6.16		6.16
T ₂ (Sole CC + RDF)		54.86	54.86		6.17	6.17
T ₃ (Oats + CC (1:1) + RDF)	17.28	31.41	48.68	2.37	3.49	5.87
T ₄ (Oats + CC (2:1) + RDF)	25.12	25.65	50.79	3.46	2.82	6.28
T ₅ (Oats + CC (1:2) + RDF)	8.04	47.03	55.06	1.09	5.22	6.32
T ₆ (Oats + CC (2:1) +75% RDF + FYM + PGPR)	24.43	31.98	56.41	3.33	3.58	6.91
T ₇ (Oats + CC (1:2) +75% RDF + FYM + PGPR)	7.99	46.60	54.59	1.08	5.20	6.29
S.Em	1.74	3.67	6.24	0.29	0.81	0.80
C.D(P=0.05)	0.548		1.923	0.09	0.03	0.07

Conclusion

Proper intercropping ratios in between the oats and chinese cabbage crop and use of the integrated nutrient management resulted in the higher growth parameters, green and dry fodder yield. intercropping of oats with chinese cabbage in 2:1 row ratio with the application of PGPR i.e., treatment in T₆. Oats + CC (2:1) + 75% RDF+ FYM + PGPR performed better among all treatments for obtaining higher green and dry fodder yield.

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