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Performance of the wheat-based intercropping system in different irrigation scheduling

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Abstract

A field experiment entitled Performance of the Wheat-Based Intercropping System In Different Irrigation Scheduling conducted during Rabi 2025-26 at Agriculture farm, Suresh Gyan Vihar University, Jaipur on sandy loam soil. The maximum effective tillers, seed, straw, biological yield of wheat were recorded with IW/CPE = 1.25 over to IW/CPE = 0.75 but remained statistically at par with IW/CPE = 1.00. The maximum net return was recorded with IW/CPE = 1.25 over to IW/CPE = 0.75 and IW/CPE = 1.00. Application of IW/CPE = 1.25 and IW/CPE = 1.00 were significantly increased B: C ratio to the extent of 46.24 and 34.42 per cent over IW/CPE = 0.75, respectively. Sole wheat recorded significantly the highest effective tillers, seed, straw, biological yield of wheat as compared to wheat + Mustard (10:2), wheat + Mustard (8:2) and wheat + Mustard (6:2). Highest net return of mustard as compared to sole wheat and sole mustard and remained statistically at par with wheat + Mustard (10:2), wheat + Mustard (8:2) and wheat + Mustard (6:2). The intercropping in Wheat + Mustard (6:2) recorded maximum B: C ratio (2.27) and proved significantly superior to sole mustard (1.26) and sole wheat (1.72).

Keywords: Intercropping, grains, siliqua, seed, wheat

Introduction

Wheat (*Triticum aestivum* L.) is one of the most widely grown staple food crops globally, after rice (Ankit *et al.* 2024) [3]. It is a primary food source for a significant portion of the global population, providing essential nutrients and energy (Kumar *et al.* 2024) [8]. Wheat is grown on 32.76 million hectares (m ha) lands with total production of 117.51 million tons (m t) contributes 34 per cent of the total food grain production in the country with the productivity of 3587 kg ha⁻¹ (Ministry of Agriculture, GOI 2023-24). In Rajasthan area under wheat crop is 2.74 m ha with production of 9.70 m t and productivity of 3540 kg ha⁻¹ (Ministry of Agriculture, GOR, 2023-24). Wheat is the backbone of food security of India. It is utilized for bread, cakes, cookies, noodles, petri-products and chapatti etc. Wheat grains contains starch 60-68%, protein 8-15%, fat 1.5-2.0%, cellulose 2.0-2.5%, and minerals 1.5-2.0% ((Alemu 2017) [2]. Wheat crop contributes substantially to the national food security by providing more than 50% of the calories to the people who mainly depend on it. While scheduling irrigation to wheat it is known that some of the critical stages are important from yield point of view. "Missing irrigation in critical stages affect the grain yield significantly". Irrigating at the right time, particularly during the crown root development phase, is crucial for wheat's optimal growth and can significantly influence its grain yield" (Raut *et al.* 2023) [9]. The success of any intercropping system relies on the appropriate selection of companion crop where, competition between them for radiation, CO₂ nutrients, moisture, spaces etc., is minimized. This can be achieved by increasing the productivity from the existing area by adopting appropriate agronomic practices, of which intercropping system can be depended as one of the best ways to increase productivity from unit available land (Chaudhari *et al.*, 2017) [5].

Methods and Materials

A field experiment entitled Performance of the Wheat-Based Intercropping System In Different Irrigation Scheduling conducted during Rabi 2025-26 at Agriculture farm, Suresh Gyan Vihar

University, Jaipur on sandy loam soil. Geographically, the study area is located at 75°48'84" E longitude and 26°82'47" N latitude and this region falls under agro-climatic zone III A (Semi-arid Eastern Plain Zone) of Rajasthan. The experiment consisting three irrigation scheduling in main plot (IW/CPE = 0.75, IW/CPE = 1.00 and IW/CPE = 1.25) and Sub plot (Sole wheat, sole mustard, Wheat + Mustard (6:2), Wheat + Mustard (8:2) and Wheat + Mustard (10:2)). The total fifteen treatment combinations were tested in split plot design with three replications.

Results and Discussion

Intercropping system

Number of effective tillers and number of grains per spike of wheat were recorded with sole wheat as compared to intercropping systems where as Wheat + Mustard (10:2), Wheat + Mustard (8:2) and Wheat + Mustard (6:2) was not significant with each other. The maximum grain yield of wheat was recorded with IW/CPE = 1.25 over to IW/CPE = 0.75 but remained statistically at par with IW/CPE = 1.00. Sufficient moisture enhances cell division and elongation, leading to better tiller formation and survival. In contrast, lower irrigation levels (IW/CPE = 0.75) might have resulted in moisture stress, thereby reducing tiller production. Similar findings were reported by Barick *et al.* (2022) [4] and Alam *et al.* (2020) [1], who observed improved tillering under higher irrigation regimes in wheat-based cropping systems. The maximum net return was recorded with IW/CPE = 1.25 over to IW/CPE = 0.75 and IW/CPE = 1.00. Application of IW/CPE = 1.25 and IW/CPE = 1.00 were significantly increased net return to the extent of 50.14 and 36.21 per cent over IW/CPE = 0.75, respectively. Although higher irrigation involves increased cost, the additional yield obtained more than compensates for the extra expenditure, resulting in higher net income. Similar observations were made by Singh *et al.* (2018) [10], who reported that appropriate irrigation scheduling enhances both productivity and profitability.

Intercropping system

Effective tillers and number of grains per spike of wheat were recorded with sole wheat as compared to intercropping systems where as Wheat + Mustard (10:2), Wheat + Mustard (8:2) and Wheat + Mustard (6:2). Sufficient moisture enhances cell division and elongation, leading to better tiller formation and survival. In contrast, lower irrigation levels (IW/CPE = 0.75) might have resulted in moisture stress, thereby reducing tiller production. Similar findings were reported by Barick *et al.* (2022) [4] and Alam *et al.* (2020) [1], who observed improved tillering under higher irrigation regimes in wheat-based cropping systems. The maximum grain, straw and biological yield of wheat were recorded with sole wheat as compared to intercropping systems where as Wheat + Mustard (10:2), Wheat + Mustard (8:2) and Wheat + Mustard (6:2). Application of sole wheat was significantly increased straw yield of wheat to the extent of 25.22, 29.33 and 43.19 per cent over Wheat + Mustard (10:2), Wheat + Mustard (8:2) and Wheat + Mustard (6:2), respectively. Wheat + Mustard (6:2) recorded significantly the highest net return of mustard as compared to sole wheat and sole mustard and remained statistically at par with wheat + Mustard (10:2), wheat + Mustard (8:2) and wheat + Mustard (6:2). Similar results were reported by Singh *et al.* (2018) [10], who observed that suitable row proportions in intercropping systems significantly enhance economic returns.

Table 1: Effect of wheat-based intercropping system in different irrigation scheduling on yield attributes of wheat

Treatments	Number of effective tillers per meter row length	Number of grains per spike
Irrigation scheduling		
IW/CPE = 0.75	99.50	36.92
IW/CPE = 1.00	106.67	39.08
IW/CPE = 1.25	109.08	40.67
SEm±	1.21	0.48
CD (P=0.05)	3.45	1.47
Intercropping system		
Sole wheat	112.56	41.78
Sole Mustard	0.00	0.00
Wheat + Mustard (6:2)	100.33	35.78
Wheat + Mustard (8:2)	102.67	38.56
Wheat + Mustard (10:2)	104.78	39.44
SEm±	1.74	0.49
CD (P=0.05)	5.09	1.44

Table 2: Effect of wheat-based intercropping system in different irrigation scheduling on yields of wheat (kg/ha)

Treatments	Grain yield (kg/ha)	Straw yield (kg/ha)	Biological yield (kg/ha)
Irrigation scheduling			
IW/CPE = 0.75	2611	3222	5832
IW/CPE = 1.00	3044	3684	6728
IW/CPE = 1.25	3154	3893	7047
SEm±	46	35	71
CD (P=0.05)	152	108	210
Intercropping system			
Sole wheat	3620	4403	8023
Sole Mustard	0	0	0
Wheat + Mustard (6:2)	2474	3075	5549
Wheat + Mustard (8:2)	2782	3405	6187
Wheat + Mustard (10:2)	2868	3516	6384
SEm±	72	82	151
CD (P=0.05)	209	239	440

Table 3: Effect of wheat-based intercropping system in different irrigation scheduling on economics of mustard (Rs/ha)

Treatments	Gross return (Rs/ha)	Net return (Rs/ha)	B: C ratio
Irrigation scheduling			
IW/CPE = 0.75	112620	74373	1.65
IW/CPE = 1.00	113119	101306	2.22
IW/CPE = 1.25	126365	111661	2.41
SEm±	1742	1742	0.04
CD (P=0.05)	5439	5439	0.13
Intercropping system			
Sole wheat	124404	78754	1.72
Sole Mustard	103475	57825	1.26
Wheat + Mustard (6:2)	149375	103725	2.27
Wheat + Mustard (8:2)	147368	101718	2.22
Wheat + Mustard (10:2)	144573	98923	2.16
SEm±	2866	2866	0.06
CD (P=0.05)	8365	8365	0.18

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