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Productivity of cotton as influenced by different weed control measures in red and black soils

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Abstract
A field experiment was conducted during *kharif*, 2018 to identify chemical weed control package in cotton with diuron as preemergence herbicide at Professor Jayashankar Telangana State Agricultural University, Rajendranagar. The experiment comprised of 7 treatments having varied doses of diuron 80% WP at 0.5 kg ha^{-1}, 0.75 kg ha^{-1}, 1.0 kg ha^{-1} and pendimethalin (1.0 kg ha^{-1}) as preemergence application followed by postemergence application of pyrithiobac sodium (62.5 g ha^{-1}) + quizalofop p ethyl 50.0 g ha^{-1}. Non herbicidal treatments comprised of polyfilm, mechanical weeding (at 20 and 40 DAS) and unweeded control. The kapas and stalk yields were higher with polymulch and mechanical weeding in both red and black soils. Among the herbicidal treatments, diuron 0.75 kg ha^{-1} recorded highest kapas yield in both red and black soils while the higher stalk yield was recorded by pendimethalin in red soil and by diuron 0.5 kg ha^{-1} in black soil.

Keywords: Diuron, pendimethalin, polyfilm, mechanical weeding, kapas yield, stalk yield

Introduction
Cotton plays an important role in the Indian economy as the country's textile industry is predominantly cotton based. India is one of the largest producers as well as exporters of cotton yarn. In Telangana, the total area under cotton is 17.78 lakh hectares in 2016-2017 as against 17.13 lakh hectares in 2015-2016 and the production is 59.50 lakh bales in 2016-2017 as compared to 57 lakh bales in 2015-2016. The productivity of cotton in Telangana is 569 kgs ha^{-1} (The Cotton Corporation of India Ltd., 2017) [10].

Weeds are one of the major constraints in cotton production which may reduce the yield upto 80% (Prabhu, 2010) [8]. In dryland situations, predominant farming situation in which cotton is grown, establishment of crop in weed free situation is the most important criteria to exploit the initial vigour and realizing the higher yields. Critical period of weed competition in cotton was found to be 15-60 days after sowing (Rajiv Sharma, 2008) [9]. In widely spaced crops such as cotton, weeds get ample opportunity to compete with cotton plants for the scarcely available soil moisture and nutrients in the early stages crop growth. Pre-emergence herbicides are the most important weed management interventions in weed-free establishment of the crop. So the application of pre-emergence herbicides provides a foundation for season long weed management.

At present, pendimethalin and alachlor are the two pre-emergence (PE) herbicides registered for use in cotton besides diuron. As alachlor is being phased out of use by 2020, pendimethalin will be the sole available preemergence herbicide registered for use in cotton. It is a well-established fact that, utilising the same herbicide over long period can have adverse effects like development of resistance in weeds and poor bio-efficacy over long periods of time. Further, continuous use of same herbicide may also negatively influence different properties of soil like soil enzyme activity and soil microbial population. Even though diuron is registered for use in cotton, its usage is very low due to long residual life and phytotoxicity. These situations necessitate use of a alternative preemergence herbicide to be used in rotation with pendimethalin for effective pre-emergence weed management. So, there emerges a need to evaluate diuron, registered for pre-emergence use in cotton, keeping in view the safe practise of rotating herbicides with different modes of action. Hence, field experiment was conducted to assess the influence of different weed control practices in cotton cultivated in red and black soils.

Material and methods

The experiment was carried out at College Farm, College of Agriculture, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, Telangana state. The farm is geographically located at 17º19' N latitude and 78º23' E longitude at an altitude of 542.6 m above mean sea level (MSL). The climate of the region is semi-arid. More than 80 % of rainfall is received from South-West monsoon (June-October). The experiment was laid out in a Randomized Block Design comprising of 7 treatments which were replicated thrice. "First Class BG II" cotton hybrid seeds of Bayer company were sown at a seed rate of 2.5 kg ha^{-1}. Seeds were sown at a spacing of 90 cm in between rows and 60 cm between plants to facilitate weeding with power weeder in both directions in case of mechanical weeding treatment. Thinning and gap filling were done within two weeks of sowing to maintain optimum plant population. Pre-emergence herbicides *viz.*, diuron 80% WP ("Karmex" of Adama India Pvt. Ltd) at 0.5 kg ha^{-1}, 0.75 kg ha^{-1}and 1.0 kg ha^{-1}; and pendimethalin 38.7% CS 677 g ha^{-1} were sprayed with knapsack sprayer fitted with flat fan nozzle at two days after sowing. Spray volume applied was 500 lit ha^{-1}. Pyrithiobac sodium 10% EC 62.5 g ha^{-1} + quizalofop p ethyl 5 % EC 50 gm ha^{-1} were sprayed at 2-3 leaf stage of the weeds *i.e.* 21 DAS. Polyfilm was spread one day before sowing and seeds were sown by making holes on film at designated spacing. Mechanical weeding was done at 20, 40, 60 DAS with power weeder (Honda F300) and an unweeded control was maintained without any weeding from sowing to harvest.

At each picking, seed cotton yield obtained from the net plot area in each treatment was weighed. The cumulative yield from three pickings in plots in each treatment was expressed as yield in kg ha^{-1}. The cotton stalk was uprooted from net plot area of treatment and sun dried for one week and the weight was recorded and then stalk yield in kg ha^{-1} was worked out.

Results and discussion

Yield

Kapas yield (kg ha^{-1})

Data regarding cotton kapas yield recorded in red and black soils is presented in table 1. Kapas yield was significantly influenced by different weed control measures in both red and black soils.

Red soil

Polyfilm treatment (1912 kg ha^{-1}) recorded significantly higher kapas yield which was followed by treatment receiving mechanical weeding (1750 kg ha^{-1}) whereas unweeded control recorded lowest kapas yield (365 kg ha^{-1}). Among the herbicidal treatments, diuron 0.75 kg ha^{-1} PE *fb* pyrithiobac sodium + quizalofop p ethyl PoE (1582 kg ha^{-1}) recorded higher kapas yield

Black soil

Polyfilm (1803 kg ha^{-1}) recorded significantly higher kapas yield which was followed by treatment receiving mechanical weeding (1652 kg ha^{-1}).Unweeded control recorded lowest yield (446 kg ha^{-1}). Among the herbicide treatments, diuron 0.75 kg ha^{-1} PE *fb* pyrithiobac sodium + quizalofop p ethyl PoE (1142 kg ha^{-1}) recorded higher kapas yield.

Polyfilm treatments recorded highest seed cotton yield in both red and black soils due to complete weed control from sowing to harvest. In case of three diuron treatments highest seed cotton was recorded in 0.75 kg/ha in both red and black soils. However, next highest yield was observed in 1.0 kg diuron/ha treatment (1495 kg ha^{-1}) in red soils and 0.5 kg ha^{-1} treatment (1355 kg ha^{-1}) in case black soils, this could be due severe phytotoxicity observed in 1.0 kg ha^{-1}treatment in black soil. Poor performance of 0.5 kg ha^{-1} diuron in red soils is due poor weed control observed in this treatment compared to higher doses of diuron. Similar results showing the varying cotton yields with different doses of diuron was earlier reported Varsha *et al*. (2018) [11], Baswaraj *et al*. (2017) [1], Hiremath *et al*. (2014) [4], Nalayini *et al.* (2011) [5].

Table 1: Yield and harvest index as influenced by weed control measures in cotton

Treatments	Red soil			Black soil		
	Yield (kg ha^{-1})		HI	Yield (kg ha^{-1})		HI
	Kapas	Stalk		Kapas	Stalk	
Diuron 80% WP 0.5 kg ha^{-1} as PE *fb* pyrithiobac sodium 10% EC 62.5 g ha^{-1} + quizalofop p ethyl 5% EC 50 g ha^{-1} as PoE.	1180	2309	33.82	1355	2461	35.50
Diuron 80% WP 0.75 kg ha^{-1} as PE *fb* pyrithiobac sodium 10% EC 62.5 g ha^{-1} + quizalofop p ethyl 5% EC 50 g ha^{-1} as PoE.	1582	3050	34.15	1442	2219	39.38
Diuron 80% WP 1.0 kg ha^{-1} as PE *fb* pyrithiobac sodium 10% EC 62.5 g ha^{-1} + quizalofop p ethyl 5% EC 50 g ha^{-1} as PoE.	1495	2742	34.57	1060	1959	35.11
Pendimethalin 38.7% CS 677 g ha^{-1} as PE *fb* pyrithiobac sodium 10% EC 62.5 g ha^{-1} + quizalofop p ethyl 5% EC 50 g ha^{-1} as PoE.	1352	3440	28.21	1275	2380	34.88
Polyfilm (250 µm thickness)	1912	3536	35.09	1803	2673	40.28
Mechanical weeding with power weeder at 20, 40, 60 DAS	1750	3304	34.62	1652	2747	37.55
Unweeded control	365	1155	24	446	1305	25.48
SE(m)±	43.67	207.94		29.92	121.49	
C.D (p=0.05)	134.54	640.63		92.17	374.29	

Stalk yield (kg ha^{-1})

The data showing stalk yield is presented in table 1.

Red soil

The significantly highest stalk yield was recorded in polyfilm (3536 kg ha^{-1}) followed by pendimethalin PE (3440 kg ha^{-1}), mechanical weeding (3304 kg ha^{-1}) and diuron 0.75 kg ha^{-1} *fb* pyrithiobac sodium + quizalofop p ethyl PoE (3050 kg ha^{-1}) which were on par with each other whereas the lower stalk yield was recorded at unweeded control (1155 kg ha^{-1}).

Black soil

The significantly highest stalk yield was recorded in mechanical weeding (2747 kg ha^{-1}) followed by polyfilm (2673 kg ha^{-1}), diuron 0.5 kg ha^{-1} PE (2461 kg ha^{-1}) and pendimethalin *fb* pyrithiobac sodium + quizalofop p ethyl PoE (2380kg ha^{-1}) which were on par with each other whereas

the lower stalk yield was recorded at unweeded control (1305 kg ha^{-1}).

In both red and black soils, treatment having polymulch recorded highest stalk yield compared to other treatments which might be due to luxuriant vegetative growth of the crop due to conservation of moisture thereby greater availability of nutrients along with reduced weed competition. The higher dose of diuron did not record in higher stalk yields due to reduced plant stand by phytotoxic effect of the chemical in black soil. Whereas unweeded control recorded lowest stalk yield due to the reduced plant population and growth of plant due to heavy weed competition for moisture, nutrients, light and space. Similar results showing the varying stalk yields with different doses of diuron was earlier reported Varsha *et al*. (2018) [11], Chetan *et al*. (2016) [3] and Chaudari *et al.* (2017) [2].

Harvest index (HI)

The data showing stalk yield is presented in table 1.

Red soil

Polymulch recorded highest harvest index (35.01) which was followed by mechanical weeding (34.62). Among the herbicidal treatments, diuron 1.0 kg ha^{-1} PE (34.57) and diuron 0.75 kg ha^{-1} PE (34.15) *fb* pyrithiobac sodium + quizalofop p ethyl PoE recorded higher than, diuron 0.5 kg ha^{-1} and pendimethalin whereas the lowest HI was noticed in unweeded control (24).

Black soil

The highest HI was recorded in polyfilm (40.28) followed by diuron 1.0 kg ha^{-1} (39.38), mechanical weeding (37.55), diuron 0.5 kg ha^{-1}(35.50), diuron 1.0 kg ha^{-1} (35.11) and pendimethalin (34.88) whereas the lowest HI was recorded in unweeded control (25.48). Similar results were also reported by Patil *et al.* (1998) [7], Panwar *et al.* (2001) [6].

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