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Studies on impact of organic and inorganic fertilizers on reproductive parameters of Ashwagandha [*Withania somnifera* (L.) Dunal]

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Abstract

Reproductive parameters are important to generate data for quality seed production from medicinal plants. In this regard, a study was undertaken to know the impact of combination of organic and inorganic fertilizers on reproductive parameters of Ashwagandha at Faculty of Forestry, BAU, Ranchi in the year 2018-19. Ashwagandha [*Withania somnifera* (L.) Dunal] is a medicinal plant belongs to family Solanaceae. The study was conducted with the help of organic and inorganic fertilizers to study the reproductive parameters of Ashwagandha. The days taken by Ashwagandha plants to start flowering (85 days) in Neem cake@5 q/ha + N₅₀:P₃₀:K₄₀ kg/ha & late flowering was recorded in FYM @ 5 q/ha + N₄₀:P₅₀:K₃₀ kg/ha (121.87 days). The days taken by Ashwagandha plants for 50% flowering (99 days) in Neem cake@5 q/ha + N₅₀:P₃₀:K₄₀ kg/ha and late flowering was recorded in FYM @ 5 q/ha + N₄₀:P₅₀:K₃₀ kg/ha (136.20 days). The days taken by Ashwagandha plants to start berry formation (129.80 days) in Neem cake@5 q/ha + N₅₀:P₃₀:K₄₀ kg/ha late flowering was recorded in FYM @ 5 q/ha + N₄₀:P₅₀:K₃₀ kg/ha (158.20 days). The days taken by Ashwagandha plants for seed harvesting (159.33 days) in Neem cake@5 q/ha + N₅₀:P₃₀:K₄₀ kg/ha late flowering was recorded in FYM @ 5 q/ha + N₄₀:P₅₀:K₃₀ kg/ha (188.79 days). From the data collected on reproductive parameters, it may be concluded that Neem cake induce early flowering in Ashwagandha, while FYM application along with inorganic fertilizers promote vegetative growth, thus retarded flowering occurrence.

Keywords: organic and inorganic fertilizers, reproductive parameters and Ashwagandha

Introduction

Ashwagandha is a popular medicinal plant of ayurveda used for making classical products like "Ashwagandharishta", "Ashwagandha Vati", etc. for immune-modulator, potency, disorder of nervous system, etc. It has been said that the uses of Ashwagandha roots may compare to get horse like power. The present study is based on the applications of fertilizers doses on reproductive behavior of Ashwagandha. The roots, which contain number of alkaloids including withanine and somniferine having medicinal properties along with reducing sugar and phytosterols and mixture of saturated and unsaturated fatty acids which are present in different parts of the plants. Ashwagandha root drug find an important place in Ayurveda for the treatment of rheumatic pain, inflammation of joints, nervous disorders, impotence and immature ageing and is considered as "Indian ginseng" (Khanna *et al.*, 2006; Kulkarni & Dhir, 2008) [2, 5]. The rasayanas apart from their use for promoting physical and mental health also provide defense against diseases and arrest ageing process (Singh *et al.*, 2001; Bhattacharya *et al.*, 2002) [5, 1].

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Material & methods

The research work was conducted during the year 2018-19 at the Experiential Learning Unit- Medicinal Plants, Nursery site of Faculty of Forestry, Birsa Agricultural University, Kanke, Ranchi under the climatic and edaphic condition of Jharkhand through its qualitative and quantitative parameters. The experiment was laid out with Split Plot Design with three main plot treatments namely M₁, M₂ & M₃ with organic fertilizers and three sub plot treatments as S₁, S₂ and S₃ which comprises various doses of inorganic fertilizers, replicated

five times. Spacing pattern adopted were 50cm x 50cm and number of plants in subplot was 12. The Poshita variety was used for the experiment. Before transplanting of the seedlings, the field was ploughed properly with an arrangement of the field in split plot design. At the time of transplanting seedlings, entire dose of phosphoric and potassic fertilizers were applied as basal dose. Similarly entire dose of organic fertilizer and half of nitrogenous fertilizer was applied as basal dose and remaining half dose of nitrogenous fertilizer was applied at initiation of flowering time.

Table 1: Details of the treatment combinations used in the experiment

Symbol	Details
M ₁ S ₁	FYM@5 q ha ⁻¹ +N ₃₀ :P ₄₀ :K ₅₀ kg ha ⁻¹
M ₁ S ₂	FYM@5 q ha ⁻¹ +N ₄₀ :P ₅₀ :K ₃₀ kg ha ⁻¹
M ₁ S ₃	FYM@5 q ha ⁻¹ +N ₅₀ :P ₃₀ :K ₄₀ kg ha ⁻¹
M ₂ S ₁	Karanj cake @ 5 q ha ⁻¹ + N ₃₀ :P ₄₀ :K ₅₀ kg ha ⁻¹
M ₂ S ₂	Karanj cake @ 5 q ha ⁻¹ + N ₄₀ :P ₅₀ :K ₃₀ kg ha ⁻¹
M ₂ S ₃	Karanj cake @ 5 q ha ⁻¹ + N ₅₀ :P ₃₀ :K ₄₀ kg ha ⁻¹
M ₃ S ₁	Neem cake@ 5 q ha ⁻¹ + N ₃₀ :P ₄₀ :K ₅₀ kg ha ⁻¹
M ₃ S ₂	Neem cake@ 5 q ha ⁻¹ + N ₄₀ :P ₅₀ :K ₃₀ kg ha ⁻¹
M ₃ S ₃	Neem cake@ 5 q ha ⁻¹ + N ₅₀ :P ₃₀ :K ₄₀ kg ha ⁻¹

Results and discussion

Table 2 represents days taken to flower initiation where less number of days taken by Neem cake @ 5q/ha with N₅₀:P₃₀:K₄₀ kg/ha (85.00 days) followed by Neem cake @ 5q/ha with N₄₀:P₅₀:K₃₀ kg/ha (85.40 days) whereas maximum days taken by FYM @ 5q/ha with N₄₀:P₅₀:K₃₀ kg/ha (121.87 days) followed by FYM @ 5q/ha with N₅₀:P₃₀:K₄₀ kg/ha (119.0 days) with a grand mean of 102.99 days. Table 3 represents days taken to 50% flowering where less number of days taken by Neem cake @ 5q/ha with N₅₀:P₃₀:K₄₀ kg/ha

(99.00 days) followed by Neem cake @ 5q/ha with N₄₀:P₅₀:K₃₀ kg/ha (99.60 days) whereas maximum days taken by FYM @ 5q/ha with N₄₀:P₅₀:K₃₀ kg/ha (136.20 days) followed by FYM @ 5q/ha with N₅₀:P₃₀:K₄₀ kg/ha (130.0 days) and FYM @ 5q/ha with N₃₀:P₄₀:K₅₀ kg/ha (130.0 days) with a grand mean of 114.98 days. Sangwan and Singh (2013) [4]. Reported that the days to 50% flowering occurred in 110.39 days with a range of 103.00 to 120.00 days and days to maturity took place at 231.29 days with a range of 223.00 to 239.00 days.

Table 2: Days to flower initiation of Ashwagandha under different treatment combinations

Organic fertilizers	Inorganic fertilizers N:P:K (kg/ha)			Mean
	30:40:50	40:50:30	50:30:40	
FYM @ 5 q/ha	115.27 ^c	121.87 ^c	119.0 ^c	118.73 ^c
Karanj cake @ 5 q/ha	103.46 ^{bc}	100.73 ^b	104.80 ^{bc}	102.99 ^b
Neem cake @ 5 q/ha	91.27 ^{ab}	85.40 ^{ab}	85.00 ^a	87.22 ^a
Mean	103.33	102.66	102.95	Grand Mean -102.99
	C.V. (%)	SE(±m)	C.D. _{5%}	
Main plot(M)	10.50	4.35	14.20	Significant
Sub plot(S)		2.79	8.15	Non-significant
Interaction (M*S)		5.88	14.11	Significant

Table 3: Days to 50% flowering of Ashwagandha under different treatment combinations

Organic fertilizers	Inorganic fertilizers N:P:K (kg/ha)			Mean
	30:40:50	40:50:30	50:30:40	
FYM @ 5 q/ha	130.00 ^c	136.20 ^c	130.00 ^c	134.06 ^b
Karanj cake @ 5 q/ha	110.60 ^b	109.00 ^{ab}	113.00 ^{bc}	110.86 ^{ab}
Neem cake @ 5 q/ha	101.40 ^{ab}	99.60 ^{ab}	99.00 ^a	100.00 ^a
Mean	114	114.93	116	Grand Mean - 114.98
	C.V. (%)	SE(±m)	C.D. _{5%}	
Main plot(M)	7.58	5.43	17.708	Significant
Sub plot(S)		2.25	6.576	Non-significant
Interaction (M*S)		6.29	11.390	Significant

Table 4 represents days taken to seed formation where less

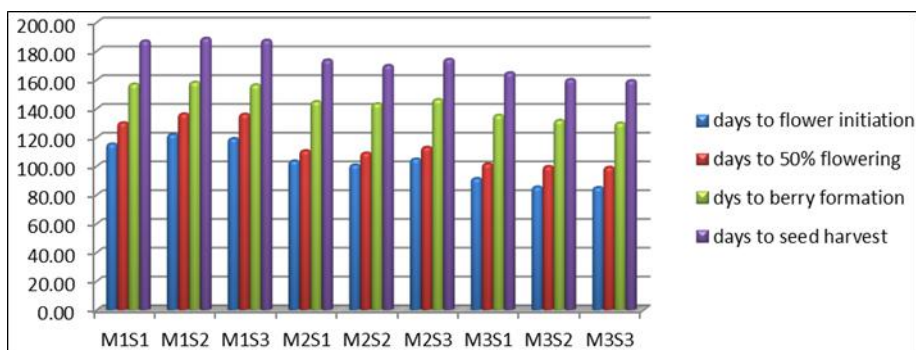
number of days taken by Neem cake @ 5q/ha with N₅₀:P₃₀:K₄₀ kg/ha (129.80 days) followed by Neem cake @ 5q/ha with N₄₀:P₅₀:K₃₀ kg/ha (131.66 days) whereas maximum days taken by FYM @ 5q/ha with N₄₀:P₅₀:K₃₀ kg/ha (158.20 days) followed by FYM @ 5q/ha with N₃₀:P₄₀:K₅₀ kg/ha (156.93 days) with a grand mean 144.69 days. FYM @ 5q/ha with N₃₀:P₄₀:K₅₀ kg/ha (135.20 days) was *at par* with Neem cake @ 5q/ha with N₅₀:P₃₀:K₄₀ kg/ha (129.80 days). Table 5 represents days taken to seed harvest where less number of days taken by Neem cake @ 5q/ha with N₅₀:P₃₀:K₄₀ kg/ha (159.33 days) followed by Neem cake @ 5q/ha with N₄₀:P₅₀:K₃₀ kg/ha (160.13 days) whereas maximum days was taken by FYM @ 5q/ha with N₄₀:P₅₀:K₃₀ kg/ha (188.79 days) followed by FYM @ 5q/ha with N₅₀:P₃₀:K₄₀ kg/ha (187.46 days) with a grand mean of 173.92 days.

Table 4: Days to seed formation of Ashwagandha under different treatment combinations

Organic fertilizers	Inorganic fertilizers N:P:K (kg/ha)			Mean
	30:40:50	40:50:30	50:30:40	
FYM @5 q/ha	156.93 ^c	158.20 ^c	156.40 ^c	157.17 ^b
Karanj cake @ 5 q/ha	144.73 ^{bc}	143.20 ^b	146.13 ^{bc}	144.69 ^{ab}
Neem cake @ 5 q/ha	135.20 ^{ab}	131.66 ^{ab}	129.80 ^a	132.22 ^a
Mean	145.62	144.35	144.11	Grand Mean - 144.69
	C.V. (%)	SE(m)	C.D. _{5%}	
Main plot(M)	6.62	7.00	22.84	Significant
Sub plot(S)		2.47	7.22	Non-significant
Interaction (M*S)		7.83	12.51	Significant

Table 5: Days to seed harvest of Ashwagandha under different treatment combinations

Organic fertilizers	Inorganic fertilizers N:P:K (kg/ha)			Mean
	30:40:50	40:50:30	50:30:40	
FYM @5 q/ha	186.93 ^b	188.79 ^b	187.46 ^b	187.73 ^b
Karanj cake @ 5 q/ha	173.66 ^{ab}	169.86 ^{ab}	174.33 ^{ab}	172.62 ^{ab}
Neem cake @ 5 q/ha	164.80 ^{ab}	160.13 ^{ab}	159.33 ^a	161.42 ^a
Mean	175.13	172.93	173.71	Grand Mean - 173.92
	C.V. (%)	SE(m)	C.D. _{5%}	
Main plot(M)	9.43	4.92	15.73	Significant
Sub plot(S)		5.01	12.36	Non-significant
Interaction (M*S)		8.63	21.42	Significant

**Fig 1:** Days to flower initiation, days to 50% flowering, days to berry formation, days to seed harvest of Ashwagandha under different treatment combinations

Conclusion

Neem cake @ 5q/ha with N₅₀:P₃₀:K₄₀kg/ha showed exceptional result in comparison to other treatment combinations. Neem cake with above N: P: K levels showed promising results in parameters like days to flower, days to 50% flowering, days to berry formation and days to seed harvest. Neem cake @ 5q/ha with N₅₀:P₃₀:K₄₀kg/ha can be recommended for profuse multiplication of Ashwagandha in breeding program. Keeping in view of the importance of Ashwagandha as a medicinal plant, present study is helpful in selection of fertilizer combination for better growth and returns. Moreover, the results will be useful in selection of high yielding species with different fertilizer combination for growth and reproductive parameters. Results will also be significant to the farmers and medicinal plant growers interested for the commercial cultivation of Ashwagandha in Jharkhand.

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