Short Communication

Performance of Kiriyath (*Andrographis paniculata* (Burm.f.) Wall. ex. Nees.) under different shade levels, dates of planting and mulching

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Abstract

A field experiment was taken under to study the effect of variations in shade levels, time of planting and mulching on yield and quality of Kiriyath (*Andrographis paniculata)*. The treatments consisted of two shade levels (open and 50 per cent shade), four dates of planting (15th May, 15th June, 15th July and 15th August), and three mulching practices (no mulching, paddy straw mulching and black polythene mulching). Higher biomass yield was obtained when planted on 15th May under shade with black polythene mulching (15.67 t ha^{-1}). However, it was on par with June planting with black polythene mulch under shaded condition (14.33 t ha^{-1}). Andrographolide, the major secondary metabolite responsible for the medicinal property, was higher when planting was in July under shade with paddy straw mulching (1.17%) and was on par with August planting with paddy straw mulching under shade (1.14%).

Key words: *Andrographis paniculata*, Black polythene mulch, Dates of planting, Kiriyath, Paddy straw mulch.

Kiriyath (*Andrographis paniculata* (Burm.f.)) Wall. ex. Nees., an important medicinal plant belonging to the family Acanthaceae, is known as "King of Bitters" and is traded in high volume and prioritized by State Medicinal Plant Board, Kerala. It is best suited to hot and humid climatic conditions but during monsoon season it can also be cultivated in subtropical regions. It is one of the foremost broadly utilized plants in ayurvedic medicines and was prescribed in Charaka Samhita dating to 175 BC for treatment of jaundice, besides other plants (Sharma, 1983). It is also used for the treatment of snake bite, diabetes, dysentery, fever and malaria. Variations in environmental conditions have great influence on production of active principles, and it is necessary to identify optimum growing conditions to grow cultivars with high yield potential. However no information is available about the effect of variations in shade levels, time of planting and mulching on yield and quality of Kiriyath (*Andrographis paniculata*).The present experiment was conducted during May - January 2017 at Agronomy farm, Department of Agronomy, College of Horticulture, Vellanikkara. The experimental site was situated at 13° 32'N latitude and 76° 26'E longitude, at an altitude of 40 m above mean sea level. The soil of the experimental site was low in pH (4.65), high in organic carbon (1.13%), low in available N (189 kg ha^{-1}) and available P (10.08 kg ha^{-1}) and medium in available K (259.84 kg ha^{-1}).The experiment was laid out in RBD (factorial), with three replications. The plot size was 3 m x 3 m with a plant spacing of 30 cm x 15 cm. The treatments comprised two shade levels (open and 50 per cent shade), four dates of planting (15th May, 15th June, 15th July and 15th August) and three mulching practices (no mulching, paddy straw mulching and black polythene mulching). Seeds were pre soaked and sown in pro trays filled with coirpith compost and watered. FYM was applied

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@ 5t/haas basal and $N:P_2O_5:K_2O$ was applied @ 80:40:20 kg/ha. Full quantity of P was applied as basally and N and K in two equal splits at 30 DAP and 60 DAP. One month old healthy, uniform sized seedlings were selected and transplanted in the main field as per the treatments.

Biometric observations were recorded from five tagged plants, at 30 and 60 DAP and at harvest. Since the whole plant is economic, entire plant was harvested by uprooting at 50 per cent flowering stage. Estimation of andrographolide content was done through high performance thin layer chromatographic (HPTLC) method (Vijaykumar et al., 2007).

Different shade levels, planting dates and mulching influenced the growth, yield and quality of Kiriyath (*Andrographis paniculata*). At the time of harvest, tallest plants were recorded under 50 per cent shaded condition (81.36 cm), planting on 15th July (79.75 cm) and mulching with black polythene (71.08 cm). According to Boardman (1977), plants that grow under shade tend to have elongated growth due to long segment of stem composed of thin walled cells, larger intercellular spaces and fewer transport tissue and binding tissues, which could be caused by the activity of auxin.

At harvest, planting under shade and 15th May recorded highest number of branches (22.86 and 22.44 numbers respectively). During the entire crop period, higher number of branches were observed in black polythene sheet, followed by paddy straw mulch. Muhammed (2015) reported improvement in height and number of branches of plants grown under polythene mulches.

Generally flowering coincided with 15th week after planting. Flowering commenced earlier in the open condition i.e., on 109th day whereas it took more days for flowering under shaded condition (116 days). Among different planting dates, 15th July planting took more number of days (118) for flowering, followed by planting in 15th August (115 days). Mulching did not show any significant influence on days to first flowering.

Shade levels, planting dates and mulching significantly influenced the total yield of *Andrographis paniculata*. The highest yield of 10019 kg ha^{-1} was noticed in the crop grown under 50 per cent shade. According to Purwanto et al. (2011), *Andrographis paniculata* prefers 25 to 50 per cent shade for better growth and development. Among different dates of planting, May planting recorded the highest biomass yield of 12873 kg

Table 1. Effect of growing condition, planting dates, and mulching on growth, yield and quality of Kiriyath

Treatments	Plant height (cm)	No. of branches	Days to first flowering	Biomass yield(kg ha^{-1})	Andrographolide (%)
Growing condition					
Open	57.22	19.62	109	8,038	0.96
50% Shade	81.36	22.86	116	10,019	1.05
CD (0.05)	1.80	0.67	1.20	466.97	0.01
Planting Date					
15-May	66.64	22.44	108	12,873	1.00
15-Jun	64.77	21.15	109	9,420	0.96
15-Jul	79.75	20.46	118	5,860	1.01
15-Aug	65.99	20.91	115	7,961	1.04
CD (0.05)	2.54	0.95	1.69	660.39	0.02
Mulching					
No mulch	68.97	20.26	113	6,656	0.97
Paddy straw mulch	67.81	20.68	112	8,182	1.05
Black polythene mulch	71.08	22.78	113	12,249	0.99
CD (0.05)	2.20	0.82	NS	571.92	0.02

Table 2. Interaction effect of growing condition, planting dates, and mulching on yield and quality of Kiriyath

Treatments	Biomass yield (kg ha^{-1})						Andrographolide (%)					
	Open			50% Shade			Open			50% Shade		
	No mulch	Paddy straw	Black polythene	No mulch	Paddy straw	Black polythene	No mulch	Paddy straw	Black polythene	No mulch	Paddy straw	Black polythene
May 15	10,855	13,304	14,735	10,059	12,611	15,673	0.91	0.99	0.96	0.95	1.10	1.09
June 15	4,861	5,660	12,005	9,863	9,796	14,337	0.87	0.95	0.89	1.06	1.02	0.99
July 15	2,405	1,617	7,806	4,293	8,805	10,235	0.99	1.00	0.94	0.98	1.17	0.95
August 15	4,117	5,629	8,925	6,794	8,030	9,739	0.93	1.04	1.05	1.08	1.14	1.01
CD (0.05)	1618	0.05										

ha^{-1} which was 54.14 per cent higher than that in July planting, which gave lowest yield. Black polythene mulching was superior with respect to total yield also. There was 45.66 per cent difference in yield between treatments with black polythene mulch and unmulched plots. Sufficient soil moisture and optimum soil temperature in the root zone, and reduced evaporation loss due to mulching might have resulted in higher yield. Ramakrishna et al. (2006) reported that groundnut plants in polythene and straw mulched plots were generally tall, vigorous and reached early flowering due to increased soil temperature and reduced loss of soil moisture. Gunasekaran and Shakila (2014) reported enhanced tuber characters and yield of medicinal coleus (*Coleus forskohlii*) under black polythene mulch. Increase in plant height and number of branches combined with congenial macro and micro meteorological conditions might have contributed to increase in total yield.

Secondary metabolites are important biochemical compounds synthesized by medicinal plants and as far as *Andrographis paniculata* is concerned, andrographolide is the most important secondary metabolite present in it. Fifty per cent shaded condition recorded higher andrographolide content (1.05%) than open condition (0.96%). Similar result of higher andrographolide content in Kiriyath under 50 per cent shaded condition and lowest under open condition was reported by Purwanto et al. (2011). This result indicates that this plant is suitable in term of growth, and is able to produce secondary metabolites under shaded condition. Among different planting dates, crops planted in August showed the highest andrographolide content. Tanguturi (2013) also observed higher andrographolide content in Kiriyath when the crop was planted during 1st week of August. Andrographolide content was significantly more in paddy straw mulched plots (1.05 %) and was minimum under no mulch condition (0.97 %).

Interaction between growing condition, planting dates and mulching significantly influenced total biomass, with increased yield in May planting with black polythene sheet under 50 per cent shade and was on par with June planting with black polythene sheet under shaded condition (15673kg ha^{-1} and 14337 kg ha^{-1}respectively). Under best treatment combination of planting and mulching (May x Black polythene), by altering only the shade level, yield increase of around 1000 kg could be observed, indicating the shade loving nature of *Andrographis paniculata*.

Regarding influence of treatment interactions on andrographolide, higher andrographolide content was found in the crop planted in July with paddy straw mulch under shaded condition and was on par with August planting with paddy straw mulch under 50 per cent shade. According to Bohnert et al. (1995), stress conditions had great impact on the metabolic pathways responsible for the accumulation of secondary plant products. Lower biomass yield recorded with the combination involving August and July planting might be due to stress condition which in turn increased the andrographolide content. Stress related increase in monoterpene concentration in sage (*Salvia officinalis*) and loss in biomass was reported by Nowak et al.(2010).

From the study it can be concluded that planting of *Andrographis paniculata* in May - June under 50 per cent shade with black polythene mulch can be recommended for high yield, quality and profit.

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