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Optimization of Seed Rate and Foliar Nutrition for Seed Crop of Dhaincha

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ABSTRACT

A field experiment was conducted on "*Optimization of seed rate and foliar nutrition for seed crop of dhaincha"* during *rabi*, 2015-16 on sandy loam soil of Agricultural College Farm, Naira. The experiment was laid out in split plot design and it was replicated thrice. Treatments comprised of three main plots *viz*., (15, 20 and 25 kg ha^{-1}) and four sub plots consists of foliar application of three fertilizers (19-19-19 @ 1% (F_1), KNO_3 @ 1% (F_2), DAP @ 1% conc. twice at one week before and after flowering) and with water spray. There was a progressive and significant increase in plant height and drymatter production seed yield, stalk yield, gross returns, net returns and B: C ratio with increase in seed rate from 15 to 20 and 25 kg ha^{-1}. Yield attributes were significantly higher with lower seed rate of 15 kg ha^{-1} compared to increased seed rates of 20 and 25 kg ha^{-1}. Foliar application of DAP, 19-19-19 and KNO_3 at 1% concentration twice at one week before and after flowering significantly increased the plant height, drymatter accumulation, yield attributes, seed yield, stalk yield, gross returns, net returns and B: C ratio compared to water spray.

Key words: *Dhaincha seed crop, seed rates, foliar nutrition, growth, yield, economics.*

The advent of green revolution has not only increased the fertilizer consumption but also overlooked the role of green manures in intensive cropping systems. But continuous use of high level of chemical fertilizers had led to the problems of soil degradation, yield stagnation and decline in factor productivity. However, in recent times, the age old practice of leguminous green manuring has received increasing attention with the growing emphasis on sustaining soil health and productivity levels in field crops. Green manuring proved to be a promising renewable nutrient rich source, which supplement or substitute partially the costly fertilizer nitrogen. Fast growing leguminous green manure crops with their adaptability to different rice based cropping pattern and ability to fix atmospheric nitrogen may offer opportunities to increase and sustain productivity and income in the rice based cropping system (Buresh and De Datta, 1991, Bar *et al*., 2000).

Dhaincha (*Sesbania aculeata* L.), an annual multipurpose legume is proved to be one of the most important *in-situ* green manure crops for rice based cropping systems. It has certain unique properties like quick germinating, fast growing, succulent, accumulates large quantities of biomass in short period with less moisture, rich in nutrients especially nitrogen, good nodulation to fix atmospheric nitrogen and easily decomposable nature and found to increase crop productivity and sustain soil health of paddies.

Dhaincha withstands salinity, alkalinity and poor drainage situation better than other green manure crops. Though the value of green manure crops in supplying nutrients and improvement in soil health is well established, green manuring practices have not been widely adapted by the farmers of Andhra Pradesh due to multiple reasons. Among them, non availability good quality, sufficient quantity of seed at appropriate time and at a reasonable price is the foremost one. A lot of work on the utility of dhaincha as green manure crop has been done. But very little efforts were made so far to increase the seed production potential of dhaincha in Andhra Pradesh.

MATERIAL AND METHODS

A field experiment was conducted during *rabi* 2015-16 at the Agricultural College Farm, Naira, Andhra Pradesh. The soil was sandy loam in texture with a pH of 6.8 and EC of 0.15 dSm^{-1}, low in organic carbon (0.33%) and low in available nitrogen (172 kg ha^{-1}), medium in available phosphorus (36 kg ha-1) and medium in available potassium (262 kg ha^{-1}). Sowing was done on 16th November, 2015 by adopting three different seed rates 15, 20, 25 kg ha^{-1} as per the treatments. Healthy and bold seeds with 89% germination were hand broadcasted on the soil as per the treatment. As it is the fallow crop grown on residual soil fertility, fertilizer application was not done. However, for implementation of treatments, 19-19-19, DAP and KNO_3 were sprayed at 1% concentration twice one week before and after flowering as per the treatments. Whereas, water spraying was done in control. To maintain optimum plant population, gap filling was done at 15 DAS and thinning was done at 20 DAS. The crop was grown on residual soil moisture upto 40 DAS and thereafter four irrigations were given at

fortnightly intervals. Three hand weedings at fortnightly intervals were carried out starting from 20 DAS to keep the plots free from weeds. All the biometric data collected following standard procedure. Statistical analysis for the data recorded was done by following the analysis of variance technique for Split Plot Design with two levels applying F-test at 0.05 level of probability and critical differences were calculated for those parameters which turned to the significant ($P<0.05$) in order to compare the effects of different treatments as suggested by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Growth parameters

Incremental levels of seed rate exerted statistically detectable influence on plant height and dry matter accumulation at 60, 90 DAS and at harvest. A progressive and significant increase in plant height and drymatter production with increase in seed rate from 15 to 20 and 25 kg ha^{-1} across all the intervals of sampling except at 30 days. The maximum height and accumulation of drymatter by the plants was recorded at higher seed rate of 25 kg ha^{-1} . The next best treatment in this regard was 20 kg seed rate ha-1. Whereas, at 30 DAS increase in seed rate did not influence the growth markedly (Table.1). Increase in plant height with increased seed rate was ascribed to increased competition especially for sunlight in the plant community leading to elongation of internodes tendering of plants to attain more sunlight due to increase in number of plants per unit area . Drymatter accumulation per unit area was reduced at lower seed rates because of less plant population per unit area, which was unable to compensate the improvements brought by individual plants. These results are found to be in agreement with the findings of Triveni *et al.* (2012) Kumar *et al*. (2006), Parlawar *et al.* (2005) and Sasikala and Veeraraghavaiah (2005).

Regarding foliar nutrition, there was a noticeable difference in plant height and dry matter accumulation at 60, 90 DAS and at harvesting stages with application of fertilizers through foliar spray. The plant height at 60, 90 DAS and at harvesting stage was found to be significantly higher with application of KNO_3 @ 1% concentration twice at one week before and after flowering (Table.1) which was however, found on a par with foliar application of 19.19.19 @ 1% concentration twice at one week before and after flowering and foliar application of DAP @ 1% concentration twice at one week before and after flowering. Regarding drymatter accrual, the foliar application of KNO_3 @ 1% concentration twice at one week before and after flowering at 60 DAS, application of 19-19-19 @ 1% concentration twice at one week before and after flowering at 90 DAS, foliar application of DAP @ 1% concentration twice at one week before and after flowering and at harvest recorded the highest drymatter accumulation. However, there was no measurable differences in plant height and drymatter accumulation among foliar application of KNO_3, 19-19-19 and DAP at 1% concentration twice at one week before and after flowering. While, the plants were of their lowest stature and dry matter accumulation in water spray at 60, 90 DAS and at harvesting stages, which was significantly inferior over rest of the treatments. Whereas, at 30 DAS, foliar application of fertilizers did not influence the plant height and accumulation of drymatter markedly. This might be due to favourable effects of foliar spray of fertilizers on plant stature as a result of higher cell elongation, cell enlargement and more chlorophyll synthesis. These results are in conformity with Singh and Gangaiah (2012), Triveni *et al.* (2012), Parlawar *et al.* (2005) in dhaincha.

Yield Attributes

The number of pods $plant^{-1}$, seeds pod^{-1} and pod length were significantly increased with decrease in seed rates from 25 to 15 kg ha^{-1}. The higher values of these parameters were recorded with lesser seed rate of 15 kg ha^{-1} followed by seed rate @ 20 kg ha^{-1} and seed rate @ 25 kg ha^{-1} and the differences were statistically measurable between treatments. While, number of pods plant-1, number of seeds pod^{-1}, pod length in dhaincha was found to be the lowest with higher seed rate 25 kg ha^{-1} (Table.2).This might be due to the fact that more availability of growth factors like solar radiation, ambient temperature, relative humidity, absorption of more water and nutrients with vigorous root system as a result of relatively less inter-plant competition and because of more space availability to individual plants under lower seed rates compared to higher seed rate. Similar observations were also made by Tripathi *et al.* (2013), Triveni *et al.* (2012), Sangeetha *et al*. (2011).

Foliar application of DAP @ 1% concentration twice at one week before and after flowering (F_1) recorded conspicuously more number of pods $plant^{-1}$, seeds pod^{-1} and pod length compared to water spray , and was on par with rest of the foliar application of fertilizers *i.e.* 19-19-19 @ 1% concentration and KNO_3 @ 1% concentration (Table.2). Noticeable differences were not obsreved in number of pods $plant^{-1}$, seeds pod^{-1} and pod length among foliar application of KNO_3, 19-19-19 and DAP at 1% concentration twice at one week before and after flowering. These parameters were minimum with water spray which was significantly lower to rest of the foliar application treatments. Nutrient supply as per needs of the crop could have enabled the plants to produce more source (biomass) to increase interception, absorption and efficient utilization of radiant energy which in turn effectively translocated into the sink *i.e.* pods. Foliar application of fertilizers during reproductive phase keeps

Table 1. Plant height and dry matter production of dhaincha as influenced by seed rates and foliar nutrition.

Treatment	Plant height (cm)				Drymatter accumulation (kg ha^{-1})			
	30 DAS	60 DAS	90 DAS	At Harvest	30 DAS	60 DAS	90 DAS	At Harvest
Seed rate (kg ha^{-1})								
P_1: 15	25.3	62.8	89.2	141.6	555	1699	3533	5864
P_2: 20	26.9	73.3	100.7	157.3	574	2079	4117	6688
P_3: 25	28.7	83.6	113.1	172.9	597	2370	4553	7490
S.Em±	0.76	1.88	2.34	3.36	11.37	29.4	95.29	150.03
CD (P = 0.05)	NS	7.4	9.2	13.2	NS	115	374	589
Foliar nutrition spraying (twice at one week before and after flowering)								
F_1: 19-19-19 @ 1%	27	76.2	103.6	161.5	577	2103	4194	6840
F_2: KNO_3 @ 1%	27.1	77	105.1	164.8	575	2109	4116	6724
F_3: DAP @ 1%	27.3	75.6	102.5	160.3	574	2088	4154	6971
F_4: Water spray	26.3	65.5	93.2	142.3	576	1898	3806	6188
S.Em±	1	2.14	2.35	3.52	18.3	71.1	85.74	210.26
CD (p = 0.05)	NS	6.3	6.9	10.5	NS	211.3	255	625
Interaction (P X F)								
S.Em±	1.49	3.2	3.51	5.28	27.45	106.6	128.61	315.39
CD (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS

Table 2. Yield attributes, yield and economics of dhaincha as influenced by seed rates and foliar nutrition.

Treatment	Number of pods plant-1	No. of Seeds pod-1	Pod length (cm)	Test weight (g/1000 grains	Seed yield (kg ha^{-1})	Stalk yield (kg ha^{-1})	Gross returns (Rs ha^{-1})	Net returns (Rs ha^{-1})	B : C Ratio
Seed rate (kg ha-1)									
P_1: 15	18.7	16.3	18.6	16.7	537	4903	21838	8988	0.7
P_2: 20	15.2	15.1	16.9	16.6	633	5818	26122	13272	1
P_3: 25	11.1	13.6	16.2	16.4	716	6673	29216	16366	1.3
S.Em±	0.44	0.39	0.49	0.47	11.95	123.8	765.24	240.3	0.03
CD (P= 0.05)	1.7	1.2	1.9	NS	47	486	NS	943	0.1
Foliar nutrition spraying (twice at one week before and after flowering)									
F_1: 19-19-19 @ 1%	16.2	16.1	17.8	16.6	627	5769	26212	13362	1
F_2: KNO_3 @ 1%	14.8	15.1	17.3	16.5	607	5607	26122	13272	1
F_3: DAP @ 1%	16.6	16.3	18.4	16.8	689	6345	26468	13618	1.1
F_4: Water spray	13.4	12.6	15.5	16.3	592	5469	24100	11250	0.9
S.Em±	0.55	0.41	0.55	0.62	15.33	141.09	898.54	277.56	0.02
CD (P = 0.05)	1.6	1.2	1.6	NS	46	419	NS	825	0.07
	10	8	10	11	7	7	10	6	10
Interaction (P X F)									
S.Em (±)	0.83	0.16	0.83	0.93	32.47	211.64	1347.8	416.34	0.04
CD (P=0.05%)	NS	NS	NS	NS	NS	NS	NS	NS	NS

the leaves viable for longer period by resupplying of nutrients that are being rapidly translocated to developing grain (Ramesh *et al.,* 2016). The results also supported by Kumawat *et al*. (2015).

The test weight of dhaincha was unaffeted by seed rates, foliar application of three fertilizers (19-19-19, DAP and KNO_3) twice at one week before and after flowering or water spray and also by their interaction.

Seed Yield

The seed and stalk yields of dhaincha was significantly influenced by seed rates and foliar application of three fertilizers (19-19-19, DAP and KNO_3) twice at one week before and after flowering along with water spray. The interaction effect between these two factors was found to be non significant (Table.2).

The seed and stalk yield was maximum with 25 kg seed rate ha-1 ($P3/P_1$) and it was significantly superior to rest of the treatments *i.e.* 20 kg seed rate ha^{-1} and 15 kg seed rate ha^{-1}. The per cent increase in seed yield of 25 kg seed rate ha^{-1} over 20 kg and 15 kg ha^{-1} seed rates was 33.5 and 11.5 per cent, respectively. Among the seed rates, seed and stalk yield with seed rate of 15 kg ha^{-1} was the minimum. Optimum plant population provides better utilization of natural resources and satisfactory absorption of nutrients and moisture from the soil due to proper development of root system, thus promote maximum growth, drymatter accumulation which leads to higher seed and stalk yields due to balanced source and sink relationship. Though all the yield attributing characters were lower at higher seed rates, these improvement by individual plants were compensated by the increased plant population per unit area under higher seed rates resulted into higher seed yield. These results are in complete agreement with the findings of Triveni *et al.* (2012), Ram and Singh (2011), Sangeetha *et al*. (2011).

Foliar application of DAP @ 1% concentration .twice at one week before and after flowering was significantly enhanced the seed and stalk yield over water spray, but remained at par with 19-19-19 @ 1% and KNO_3 @ 1% concentration. There was no statistically detectable variation in seed yield with foliar application of three fertilizers (19-19-19, DAP and KNO_3) twice at one week before and after flowering. Water spray (control) found to be inferior in seed and stalk yield over rest of the treatments. As higher growth stature and larger yield structure associated with foliar application with water soluble fertilizers might have enabled to produce greater sink size. The increase in seed yield of pulses with foliar application of nutrients could be attributed to reduced flower drop and increased fruit set percentage. KNO_3 acts as osmo-protectant and have profound effect on the crop growth through their effects on water uptake, root growth, maintenance of turgor and transpiration in leaves and hence improve the yield attributes of crops (Balwinder Kumar *et al.* 2014). These results are in complete agreement with the findings of Singh and Gangaiah (2012), Bahr (2007), Parlawar *et al.* (2005).

Economics

Significantly higher gross, net returns and B: C ratio was registered with 25 kg ha^{-1}, while 20 kg ha^{-1} recorded as next best value and the minimum B: C ratio was found to be associated with the lowest seed rate of 15 kg ha^{-1} tried (Table.2). This is due to fact that increased seed yield associated with increased seed rates. These results are in line with those reported by Triveni *et al.* (2012), Sangeetha *et al*. (2011), Kumar *et al.* (2006), Parlawar *et al.* (2005) and Yaragoppa *et al.* (2003**).**

As regards the foliar application of three fertilizers (19-19-19, KNO_3 and DAP) twice at one week before and after flowering along with water spray, the net returns and B: C ratio were found to be significantly highest when DAP @ 1% concentration sprayed twice at one week before and after flowering which was however, found on par with 19-19-19 @ 1% twice at one week before and after flowering and KNO3 @ 1% concentration twice at one week before and after flowering . The net returns and B: C ratio were minimum with water spray twice at one week before and after flowering and found significantly inferior to rest of foliar treatments. (Table.2). But however gross returns were not significantly influenced by foliar application of fertilizers. Similar findings were reported by earlier workers (Ramesh *et al*., 2016 in black gram, Vinoth Kumar *et al.,* 2013 in soybean, Kuttimani and Velayutham (2011) in green gram).

CONCLUSION

From this study, it can be concluded that broadcasting the seed @ 25 kg ha^{-1} and foliar application of DAP or 19.19.19 or KNO_3, @ 1% concentration twice at one week before and after flowering was found to be optimum for reaping higher seed yield and profits in rice fallow dhaincha.

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