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Nipping-Agronomic Approach for Enhancing the Pulses Production: A Review

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ABSTRACT

Pulses are an important protein source for vegetarian people across the world and they have a great potential to improve the human health, contribute to global food and nutritional security. Variety of pulses were grown in India with 25% of global production and 27% of global consumption. Though India is the largest pulses producer in the world, it imports around 3.5 million tons annually to meet the ever-increasing requirement. Less adoption of improved Agro techniques, low fertile soils and unpredictable environment conditions are major factor for low production of pulses. As a results of increasing population, the projected pulses requirement will be 32 million tons by 2030 which necessitate annual growth rate of 4.2%. With adoption of suitable agronomic strategies, the productivity has to be enhanced to meet the demand. This review work was done at Department of Agronomy, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India. Collected review and research papers were screened from various data base like TNAU e library, ARCC journals, google scholar, research gate and scopus used to write this paper. This review article documented information gathered on importance of pulses, area, production and productivity of pulses. Nipping is important agronomic practices that removes the apical bud dominance and promotes the lateral growth which turn better maintenance of source and sink relationship and enhance the pulses yield. Influence of nipping on growth and yield of various pluses crops has been discussed here.

Key words: Agronomic approach, Enhance the yield, Nipping, Pulses.

Pulses continue to be an important ingredient of human diets specially, the large vegetarian population in the country. After cereals, Pulses are the important group of food crops consider as a protein source for both human as well as animal nutrition (Bhatt and Karim, 2009) and it play a vital role in national food and nutritional security. Because of its nutritional benefits pulses become a valuable component of healthy food system. A majority of Indian population (40%) is vegetarian and pulses play an important role in providing protein (22%) and other essential nutrients to the large population of the country (Sivasankari *et al*., 2019). As a result of increasing population, we are in need to produce more foods to feed our nation including pulses from the available land to ensure the nutritional security. Although the production of pulses has increased to some extent, the per capita availability has declined substantially. It implies that the increase in production has not kept pace with the growing population, which shows a sharp decline in the per capita availability of pulses in the recent years and it has come to less than 40 g/day at present against the normal requirement of 69 g/day (Teggelli *et al*., 2020).

Around the world India is the largest producer and consumer of pulses accounting for about 25% of the production, 27% of consumption and 34% of the food use (Pooniya *et al*., 2015). However, the area under pulse cultivation is fluctuating from year to year due to unsatisfactory cultural practices, insufficient quality seeds, low fertility soil, number of biotic and abiotic stresses, which are responsible for a large extent to the instability and low yields. By 2030 the population of India will be expected to touch 1.68 billion and the projected pulses requirement will be around 32 million tones with required annual growth rate of 4.2% (Sarkar *et al*., 2018). To meet our demand and achieve self-sufficient in pulses production, the productivity has to be increased from the current level of 834 kg ha^{-1} to 1200 kg ha^{-1}. In this grim scenario of demand, supply and consumption, the pulse production needs to be doubled in order to meet the requirement of increasing population. It can be possible only by enhancing the productivity of pulses. To achieve this goal and attain the maximum productivity of pulses, agronomic practices have to be standardized.

Nipping is an important agronomic approach to arrest the apical bud dominance and enhance the lateral growth which will ultimately increase the number of productive branches and ultimately yield (Reddy and Narayanan, 1987). Hence nipping plays an important role for increases the source sink relationship for ameliorating the yield of pulses (Sanbagavalli *et al*., 2020). However, while practicing nipping

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the time of nipping should be optimized to enhance the yield. Through symbiotic nitrogen fixation, pulse crops play a significant role in low-input agriculture by reducing the dependence on nitrogenous fertilizers. The deep and prolific tap root system helps in opening up of the soil to deeper strata providing better environment for increase microbial population and their activities. Thus, contribution to pulses in improving soil fertility is a key factor in sustaining the production (Varatharajan *et al*., 2019).

Since limited data is available on nipping in pulses. Hence an attempt has to be done to collect the available literature with respect to influence nipping on growth and yield attributes of pulses which in turns enhance the productivity.

Nutritional benefits of pulses

Pulses provide a significant nutrients and health benefits and well known to reduce several non-communicable diseases such as colon cancer and cardiovascular diseases. In children the consumption of pulses would help to furnish the necessary amino acids required for growth. In adults, protein helps in the repair of body tissue, synthesis of enzymes and hormones and also the supply of energy. The fiber in the pulses may improve the heart health by lowering the cholesterol levels (Burkitt and Trowell, 1985). Apart from protein and fiber pulses are the significant source of vitamins and minerals, such as iron, zinc, folate and magnesium. The vitamins present in appreciably quantities in pulses are thiamin, riboflavin, pyridoxine and folic acid. Vitamin E and K also found in pulses in addition to this pulse are high in fiber and have a low glycemic index, making them particularly beneficial to people with diabetes by assisting in maintaining healthy blood glucose and insulin levels. Pulses consumption also improves serum lipid profiles and positively affects several other cardiovascular disease risk factors, such as blood pressure, platelet activity and inflammation (Mudryi *et al*., 2014). Consumption of pulses in daily diet is a healthy way to meet dietary recommendation and it associated with reduced the risk of chronic diseases. The nutritional values of pulses are furnished in the Table 1.

Scenario of pulses in India

The trends of area, production, productivity and per capita availability of pulses are discussed here. The share of pulses to the total food grain basket is around 9-10 per cent and it is a critical and inexpensive source of plant-based proteins, vitamins and minerals. The total world acreage under pulses cultivation is about 85.40 million hectares with the production of 87.40 million tones and the productivity level is 1023 kg ha^{-1}. During 2018-19 India contribute more than 90% worlds total pulses production which is from an area of 29.36 million hectares and recorded highest ever production of 24.51 million tones with a productivity level of 835 kg ha^{-1}. The details of area, production and productivity of pulses in India are presented in the Fig 1. There was a sudden rise in area, production, productivity due to promotion and support by Government of India during International year of pulses. Likewise, the per capita availability of pulses has enhanced during 2017 to ensure the nutritional security of India and it has risen up to 52.90 g/head/day or 19 kg/annum/person (Fig 2).

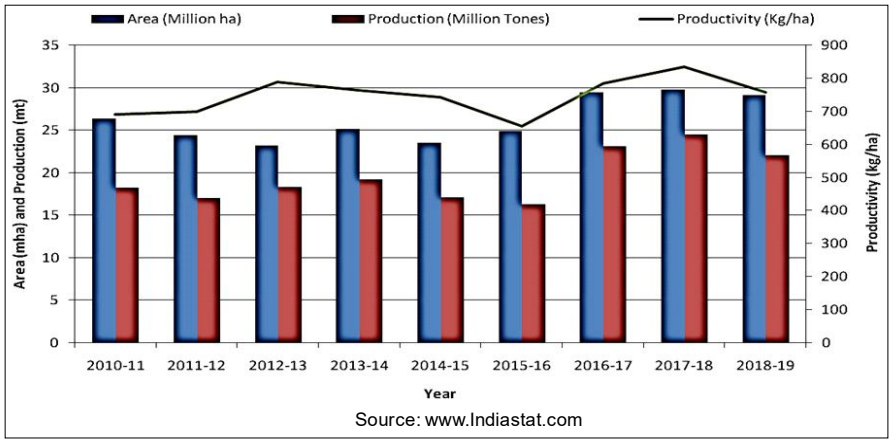
Nipping- An agronomic approach

Nipping is a well-known important agronomic manipulation in pulses to arrest the apical growth and increase the lateral branches for maximizes the yield parameters and yield. Nipping at the optimum stage of crop growth increases the vegetative growth of the plant, yield parameters and yield. It also plays an important role for maintenance of source - sink relationship for increased photosynthetic efficiency and finally improve the yield and productivity of pulses. Though nipping has been done majorly in pulses, it has a vast scope in other crops also. However, the time of nipping has to be standardized to enhance the maximum yield.

Table 1: Nutritional values of various pulses.

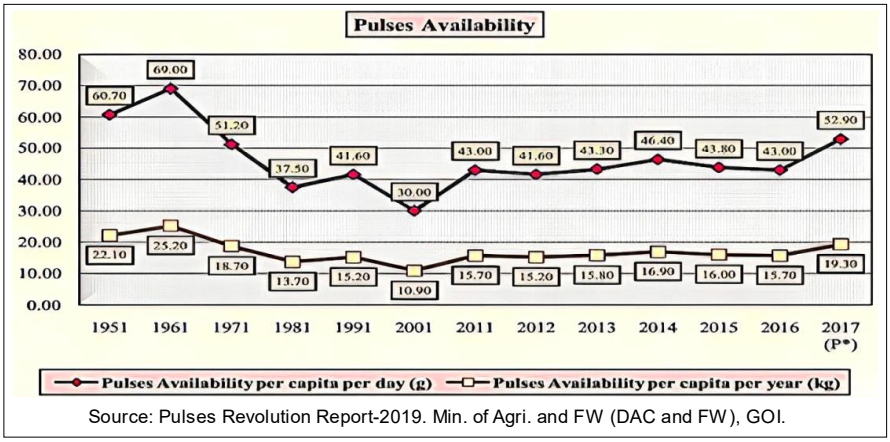
Name of the food stuff	Gram	Urd	Mung	Kulthi	Lentil	Pea	Tur	Moth	Khesari	Cowpea
	(Unit- mg/100 g)									
Protein (%)	20	24	25	22	25	22	22	25	31	23
Vit. A (I.U.)	316	64	83	119	450	31	220	16	200	60
Vit. C	3	-	-	1	-	-	-	2	-	-
Vit. K	0.29	0.19	-	-	0.25	-	-	-	-	-
Thiamine	0.3	0.41	0.72	0.42	0.45	0.47	0.45	0.45	0.39	0.5
Riboflavin	0.51	0.37	0.15	0.2	0.49	0.21	0.51	0.09	0.41	0.48
Nicotinic-acid	2.1	2	2.4	1.5	1.5	3.5	2.6	1.5	2.2	1.3
Biotin (g/100 g)	10	7.5	-	-	13.2	-	7.6	-	7.5	202
Choline	194	206	-	-	299	-	183	-	-	-
Folic acid (g/100 g)	125	144	-	-	107	-	83	-	100	-
Inositol	240	90	-	-	130	-	100	-	140	-
Pantothenic acid	1.3	3.5	-	-	1.6	-	1.5	-	2.6	-
Total no. of vitamins/minerals	12	11	-	6	11	-	10	-	9	6

Source: Pulses Revolution Report-2019. Min. of Agri. and FW (DAC and FW), GOI.



Source: www.Indiastat.com

Fig 1: Area, production and productivity of pulses in India.



Source: Pulses Revolution Report-2019. Min. of Agri. and FW (DAC and FW), GOI.

Fig 2: Percapita availability of pulses in India.

Effect of nipping on plant height

Plant height is the direct measure of vigor and growth of the plant. Generally, the plant height is gradually increased from seedling stage and attains maximum at harvest. In pulses early loss of apical dominance results in reduced the plant height and increased the number of branches (Sharma *et al*., 2010). In pigeonpea variety PKV-TARA nipping at 60 DAS registered 10.2% reduction of plant height over nipping at 90 DAS and 25.7% plant height was reduced over no nipping (Kolhe *et al*., 2019). Nipping with optimum time will arrest the vertical growth of the plant and promotes a greater number of horizontal branches results reduced the plant height. Nipping at start of branching significantly reduced redgram plant height (243.2 cm) compared to nipping at start of flowering (246.7 cm) and no nipping (260.6 cm) (Dhaka *et al*., 2020). Nipping of terminal bud of redgram at 45 and 60 days after sowing reduced the plant height *viz*. 215.9 cm and 215.1 cm compare to no nipping (221 cm) was reported by Veeranna *et al*. (2020).

Nipping in cowpea recorded substantially lower plant height compared to no nipping treatment. Singh and Singh (1992) reported that Peas plant height was reduced and the numbers of branches were increased for pod formation because of pinching of apical portion at 60, 75 and 90 days after sowing. Plant height of field pea was reduced due to primary nipping on 30 DAS followed by 40 DAS of secondary nipping (Dhital *et al*., 2017). Gnyandev *et al*. (2019) state that terminal clipping of shoot tip at 30 DAS arrest the vertical growth and enhance the horizontal growth of the plant and also noticed that in chickpea non nipped plants recorded higher plant height at 60 DAS (37.38 cm) and harvest (44.23 cm) against nipped plant.

Detopping in soybean significantly reduced the plant height, increased the total dry matter accumulation plant^{-1}, number of pods plant^{-1}, seed yield over control and also enhanced the growth attributes such as crop growth rate, relative growth rate and net assimilation rate over control was reported by Jaidka *et al*. (2018).

Effect of nipping on number of branches plant^{-1}

Number of branches is an important parameter to obtain higher yield. The nipping practice arrests the apical bud dominance and increased a greater number of secondary branches. The arrest of apical dominance resulted in diverting the polar transport of auxins towards the basal nodes leading to increase the number of secondary branches and subsequently enhanced the source-sink

relation resulting in increased yield (Bhavana *et al*., 2019) Higher number of primary branches plant^{-1} and secondary branches plant^{-1} were recorded in redgram due to nipping at 60 days after sowing and it leads to considerable increase number of pods plant^{-1} (Sharma *et al*., 2010). Dhaka *et al*. (2020) reported that higher number of primary branches plant^{-1} and secondary branches plant^{-1} in redgram was recorded in nipping at start of branching compare to nipping at start of flowering and no nipping. Redgram nipping at 45 days after sowing recorded maximum number of branches plant^{-1} (11.6) over nipping at 60 days after sowing (10.6), nipping at both 45 and 60 days after sowing (10.0) and no nipping (9.6) under rainfed condition (Veeranna *et al*., 2020).

Aziz (2000) reported that higher number of branches plant^{-1} in chickpea was recorded in nipping at 30 days after emergence and it was statistically similar to nipping at 45 days after emergence. Nipping in chickpea increased the number of pods bearing branches, total dry matter production and higher crop growth rate at maturity (Aslam *et al*., 2008).

Terminal clipping in cowpea recorded reduced plant height, higher dry weight, maximum number of leaves and more number branches which resulted in higher seed yield over control (Reddy, 2005). Cowpea nipping resulted in a greater number of branches (4.5), higher plant dry weight (8.97 g), higher seed yield (12.50 q ha^{-1} and higher protein content (22.17) compared to non-nipping (3.7, 6.07 g, 11.11 q ha^{-1} and 22.00 respectively) reported by Prashant *et al*. (2012).

Effect of nipping on dry matter production

Dry matter production is an important parameter to determine the growth of the plant. The efficient utilization of available resources of the crop is only reflected by the dry matter production. The dry matter production of the crop will increase linearly and attain maximum at harvesting stage of the crop. Nipping increased the number of secondary branches and number of leaves leads to increased LAI which resulted in the maximum dry matter production (Paikra *et al*., 2018). Increased dry weight can be attributed due to increasing the number of branches per plant, increased photosynthesis and better carbon partitioning between the source and sink (Choudhary, 2011). In redgram higher number of branches plant^{-1}, higher plant dry weight and higher seed yield was observed due to nipping at 35 days after sowing compared to control and other treatments (Patel and Acharya 2011). Nipping in redgram variety PKV-TARA at 60 days after sowing recorded the maximum dry matter production (106.27 g plant^{-1}) compared to nipping at 90 days after sowing (98.87 g plant^{-1}) and control (95.80 g plant^{-1}) was reported by Kolhe *et al*. (2019). Redgram higher dry matter production (5172 kg ha^{-1}, leaf area index (2.68) and crop growth rate (3.93 g m^{-2} plant^{-1}) in nipping plot compare to non-nipping plot (3945 kg ha^{-1}, 2.08, 3.45 g m^{-2} plant^{-1} respectively) (Srinivasan *et al*., 2019).

Effect of nipping on yield and yield attributes

Nipping of terminal buds increases the more lateral buds which turn more branches which ultimately increases the yield. Sharma *et al*. (2010) stated that in redgram (Cv.TS-3) the higher the seed yield (1560 kg ha^{-1}) was recorded due to terminal nipping at 50 DAS at 90 × 10 cm plant geometry compared to other treatments. Seed yield of redgram was increased up to 25.8% when the nipping was done and yield attributes like number of branches plant^{-1} (17.29), number of pods plant^{-1} (150) and number of seeds plant^{-1} (4.28) were higher in nipping treatment compared to no nipping (14.23, 121, 4.23 respectively) (Srinivasan *et al*., 2019). Significantly higher pods plant^{-1} (182.6) and the seed yield (1440.0 kg ha^{-1}) in redgram were recorded with nipping at start of branching compared to nipping at start of flowering and no nipping (Dhaka *et al*., 2020). In medium duration redgram nipping at 45 days after sowing recorded higher grain yield (1688 kg ha^{-1}) compared to nipping at 60 days after sowing (1493 kg ha^{-1}), nipping at 45 and 60 days after sowing (1386 kg ha^{-1}) and no nipping control (1412 kg ha^{-1}) under rainfed condition (Veeranna *et al*., 2020). Early nipping arrest the vertical growth of the plant and increases the more lateral branches, thus modify the canopy architecture by increased the canopy size and photosynthetic activity leads to enhance the grain yield (Lakshmi *et al*., 2015). Teggelli *et al*. (2020) stated that the nipping of the terminal bud in red gram between 45 to 50 days of the crop growth stage recorded the maximum yield compared to no nipping during 2016, 2017 and 2018 under rainfed condition. Panda *et al*. (2020) found that the nipping in redgram variety Asha (ICPL 87119) at 45 days after sowing recorded higher grain yield (1416 kg ha^{-1}) compared to nipping at 60 days after sowing (1341 kg ha^{-1}) and no nipping control (1182 kg ha^{-1}) under rainfed condition.

Huang (1987) found that in *Vicia faba*, topping at early flowering stage recorded higher seed yield compared to control. Increased number of pods (15.8 plant^{-1}) was mainly due to topping at early flowering stage whereas the plants topped at late flowering stage produced 3.6 per cent lower seed yield. Reddy (2010) find out that in cowpea, nipping and application of growth retardants increased the number of pods, pod length, number of seeds per pod, 100 seed weight and harvest index.

According to Baloch and Zubair (2010) maximum seed yield of 1792 kg ha^{-1} in chickpea was recorded over control plot due to nipping. Chickpea the higher yield parameters likes number of branch plant^{-1} (8.9), number of pods plant^{-1} (36.3), number of seeds pod^{-1} (1.66), 100 seed weight (16.4 g) and seed yield (2,532 kg ha^{-1}) were observed with nipping compared to control (4.2, 24.5, 1.6, 18.0 g and 1656 kg ha^{-1} respectively) (Khan *et al*., 2006). Kumar *et al*. (2018) reported that nipping at 55 days after sowing recorded decreased plant height but increased the number of branches plant^{-1}, 100 seed weight (28.61 g), number of seeds per pod (4.87) and seed yield (2,166 kg ha^{-1}) over control plants. Nipping at 45 days after sowing in chickpea increased the number of pods plant^{-1} compared to no nipping

(Sujatha *et al*., 2017). Kumar *et al*. (2018) stated that different date of sowing, different spacing and nipping significantly influenced the yield and dry matter accumulation in chickpea and the results of the experiment indicated that the third week of November sowing with nipping at 40 DAS recorded higher number of branches plant^{-1} (34.96), dry matter accumulation plant^{-1} (40.18), number of root nodules plant^{-1} (45.93), dry weight of the nodules plant^{-1} (0.72 g) and leaf are index (4.86) compare to all other treatments. Pinching and foliar spraying of micronutrient mixture ($ZnSO_4$ 0.5% + Boric acid 0.3%) in chickpea considerably increased the number of pods plant^{-1} and seed yield ha^{-1} (Nayak *et al*., 2017). Reddy (1997) stated that higher pod yield in chickpea was recorded over control due to nipping at terminal and lateral branches at 60 days after sowing. Vyakaranahal *et al*. (2002) reported that higher seed weight, seed recovery percentage, test weight and maximum seed yield was obtained in chickpea due to nipping at 40 to 60 days after sowing. In chickpea the maximum number of pods plant^{-1} were recorded due to nipping at 30 DAS observed by Aziz (2000).

Thakur and Lakpale (2014) revealed that in soybean, nipping at 6 leaf stage + nipping of lateral branches (15 days after 1st nipping) recorded higher number of branches plant^{-1} dry matter accumulation and leaf area index compare to other nipping treatments and control. In soybean, nipping at 6 leaf stage + 2nd nipping of lateral branches (15 days after 1st nipping) recorded the maximum number of branches, dry matter accumulation, LAI, CGR, RGR, yield attributes and harvest index over other nipping treatments and control (Swati and Rajendra, 2014).

Effect of nipping on economics

Effective utilization of available resources and nipping at optimum time will enhance the maximum yield which ultimately increases the higher returns. Sharma *et al*. (2010) stated that in redgram the highest gross income (Rs. 24,180 ha^{-1}), net income (Rs. 16,068 ha^{-1}) and benefit cost ratio (1.98) was obtained due to nipping at 50 DAS at 90 × 10 cm spacing. Redgram topping at 60 days after sowing recorded maximum seed yield (2,921 kg ha^{-1}), net returns (Rs.109698 ha^{-1}) and benefit cost ratio (3.55) over nipping at 45 days after sowing (2,467 kg ha^{-1}, Rs. 85,055 ha^{-1} and 3.05) and control (2,191 kg ha^{-1}, Rs. 71,801 ha^{-1} and 2.76 respectively) (Ware *et al*., 2018). Nipping in redgram increased the gross return (Rs. 85,320 ha^{-1}) and net returns (Rs. 62,765 ha^{-1}) (Srinivasan *et al*., 2019).

Bikram *et al*. (2013) found that application of 40 kg N ha^{-1} in two equal splits *viz*., 1/2 N as basal+1/2 N at 30 DAS along with nipping of terminal bud by hand clipping at 30 days crop stage recorded maximum net return (Rs. 8359 ha^{-1}) and benefit cost ratio (1.79) over other treatments in sesame. Patel *et al*. (2011) found that terminal clipping at 30 days after sowing recorded higher the seed yield (1,229 kg ha^{-1}), stalk yield (2,605 kg ha^{-1}), net return (Rs. 63,353 ha^{-1}) and benefit cost ratio (3.76) compare to terminal clipping 20 days after sowing, (979 kg ha^{-1}, 1,917 kg ha^{-1}, Rs. 44,502 ha^{-1} and 2.84 respectively) terminal clipping 40 days after sowing (1,065 kg ha^{-1}, 2,206 kg ha^{-1}, Rs. 53,287 ha^{-1} and 3.48, respectively) and no clipping (757 kg ha^{-1}, 1,823 kg ha^{-1}, Rs. 34,851 ha^{-1} and 2.90, respectively). Singh and Devi (2006) stated that in peas, nipping at 30 days after sowing recorded the highest net return (Rs. 13799.5 ha^{-1}), it was followed by nipping at 35 days after sowing (Rs. 13759.5 ha^{-1}) over no nipping control (Rs. 5254.9 ha^{-1}). Patil *et al*. (2020) stated that nipping at 30 days after sowing along with foliar application of salicylic acid and 2% DAP recorded highest seed yield (541 kg ha^{-1}), net monitory return (Rs. 39,210 ha^{-1}) and B:C ratio (2.93) over no nipping (425 kg ha^{-1}, Rs. 27,650 ha^{-1} and 2.45, respectively).

CONCLUSION

Since India placed first position in area and production of pulses the productivity still remains under below average. Less adoption of improved agronomic practices, non-availability of inputs at proper time and less care about plant protection measures are causes severe yield loses of pulses which threatening the national food and nutritional security. To avoid these conditions nipping is an important agronomic practice has to be adopted by the farmers to improve production of pulses. To achieve this goal extension people should disseminate the technology on providing knowledge and skills to the farming community. This may be helping in minimize the yield gap and increase productivity and production of pulses which leads food and nutritional security India.

Conflicts of interest

The authors are declaring that there is no conflict of interest in the publication of the paper.

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