Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(1): 2280-2283
Received: 25-11-2018
Accepted: 27-12-2018

Jyotiprakash Mishra
Department of Agronomy, O.U.A.T., Bhubaneswar, Odisha, India

Rajesh Kumar Singh
Department of Agronomy, B.H.U., Varanasi, Uttar Pradesh, India

DeshrajYadaw
Department of Agronomy, B.H.U., Varanasi, Uttar Pradesh, India

Sabyasachi Sahoo
Department of Agronomy, O.U.A.T., Bhubaneswar, Odisha, India

Ambika Prasad Mishra
Department of Soil Science & Agricultural Chemistry, O.U.A.T., Bhubaneswar, Odisha, India

Correspondence
Jyotiprakash Mishra
Department of Agronomy, O.U.A.T., Bhubaneswar, Odisha, India

Quality of Indian mustard [*Brassica juncea* (L.) Czernj and Cosson] as influenced by tillage and irrigation frequency

Jyotiprakash Mishra, Rajesh Kumar Singh, DeshrajYadaw, Sabyasachi Sahoo and Ambika Prasad Mishra

Abstract
A field experiment was conducted during the *rabi* season of 2014-15 at Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh (India) to study the effect of tillage and irrigation frequency on productivity of Indian mustard [*Brassica juncea* (L.) Czernj and Cosson]. The experiment was laid out in split-plot design with three replications. The main plot treatment consisted three tillage practices *viz.* Zero tillage, Reduced tillage (2 harrowing + 1 planking), Conventional tillage (1 deep ploughing with disc + 2 harrowing + 1 planking), whereas four levels of irrigations *i.e.*No irrigation, One irrigation (35 DAS), Two irrigations (35 DAS + 60 DAS), Three irrigations (35 DAS + 60 DAS + 90 DAS) were allocated to sub-plots. The seed yield increased with increasing intensity of tillage operations. Conventional tillage produced 30.6% and reduced tillage recorded 10.2% higher seed yield than and zero tillage. Application of one irrigation, two irrigations and three irrigations recorded 7.8, 18.6% and 24.2% higher yield as compared to the control. The maximum oil yield of 596kg ha^{-1} was obtained with conventional tillage that recorded 7% and 16% higher oil yield than reduced tillage and zero tillage. Increasing intensity of tillage from zero tillage to conventional tillage caused significant increase in protein yield. The protein yield (kg ha^{-1}) of mustard also improved with increase in irrigation frequency up to three irrigations.

Keywords: Mustard, tillage, irrigation frequency, quality, yield, oil, protein

Introduction
Oilseeds play a vital role in Indian economy, accounting for 5% of gross national product and 10% of the value of agricultural product. In India, oilseeds are the second largest agricultural commodity after cereals, which occupy about 13.5% of the gross cropped area in the country. India is the fourth largest oilseed economy in the world after the U.S., China and Brazil, and it is the second largest importer after china (Anonymous 2014). The country accounts for 15 per cent of global oilseeds area, 7 per cent of vegetable oils production and 10 per cent of the total edible oils consumption (Jha *et al.*, 2012). Rapeseed-mustard is the third important oilseed crop in the world after soybean (*Glycine max*) and palm (*Elaeisguineensis* Jacq.). Among the seven edible oilseeds cultivated in India, rapeseed-mustard (*Brassica* spp.) contributes 28.6% to the total production of oilseeds. It ranks second in oilseeds production after groundnut, sharing 27.8% in the India's oilseed economy. Indian mustard accounts for about 75-80% of the 5.8 m ha of rapeseed and mustard with the productivity of 1142 kg ha^{-1} in the country. Mustard seed has 36% protein content with a high nutritive value. The oil content varies from 37 to 42%. It is a winter (*Rabi*) season crop that requires relatively cool temperature, a fair supply of soil moisture during the growing season and a dry harvest period. In the eastern Uttar Pradesh region the crop is primarily grown as a mixed crop mainly with wheat in rice wheat cropping system. As a pure crop it is grown on marginal lands under constraints of delayed sowing, nutrient, irrigation and plant protection. Therefore, to maintain the increasing production trend of Rapeseed and mustard in the country, it becomes imperative to boost the productivity of mustard in this region.

The productivity of Rapeseed-Mustard in Rice-Mustard system is low due to many related problems. The major contributory causes are delayed sowing. Cultivation of mustard after puddled transplanted rice requires relatively more tillage operations to bring the required tilth. Puddled soil generally becomes heavy due to breaking of water stable aggregates, increased bulk density and soil impedance. However, this loss can be minimized through manipulation of tillage operations enabling early sowing of mustard by adopting the concept of reduced tillage system. Owing to its hardy nature and capacity to thrive well under poor condition of moisture, mustard is raised without adequate irrigation. This practice results in low yields

(Rathore *et al.*, 1999) [14]. Water is costly and scarce input. Its judicious use is an important aspect to get maximum efficiency under resource conditions. Irrigation water has to be utilized in a manner that matcher the crops need. Optimum crop yield is not possible without application of timely and right amount of irrigation water. The yield of mustard in India is low as the crop is grown under rainfed condition. The crop is usually grown during November to January. Since rainfall during this period is inadequate and uncertain, mustard requires supplemental irrigation for its proper growth and development, otherwise the crop is likely to suffer from water stress and reduce ultimately the yield. In general, irrigation can be supplied to the crop based on the critical stages which are governed by the irrigation frequency or the number of irrigation given to a crop during its lifecycle. In general it can be stated that out of the four stages *viz.* the mid-season stage is most sensitive to water shortages (Brouwer *et al.* 1989). This is mainly because it is the period of highest crop water need. If water shortages occur during mid-season stages, the negative effect on the yield will be pronounced. The least sensitive to water shortages is the late season; this stage includes ripening and harvest. The growth stages of mustard are: vegetative stage, flowering stage, pod development stage, seed filling and ripening stage. Two irrigations one at pre-flowering and other at pod development stage are necessary for maximum seed yield of mustard (Ali, 1997).

Materials and Methods

The field experiment was conducted during the *Rabi* season of 2014-15 at Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh (India). The soil of experimental site was Gangetic alluvial having sandy clay loam texture with *p*H 7.4. Experimental soil was moderate in fertility with organic carbon of 0.35 per cent and available nitrogen content being 212.4 kg ha^{-1}, available phosphorus (25.7 kg ha^{-1}) and available potassium (187 kg ha^{-1}) in soil. "Ashirwad" variety of mustard was used for the experiment. The experiment was laid out in split-plot design with three replications. The main plot treatment consisted three tillage practices *viz.* Zero tillage, Reduced tillage (2 harrowing + 1 planking), Conventional tillage (1 deep ploughing with disc + 2 harrowing + 1 planking), whereas four levels of irrigations *i.e.*No irrigation, One irrigation (35 DAS), Two irrigations (35 DAS + 60 DAS), Three irrigations (35 DAS + 60 DAS + 90 DAS) were allocated to sub-plots. So the total numbers of treatment combinations were twelve. The treatments were replicated thrice to avoid any effect of heterogeneity.

Result and Discussion

The seed yield increased with increasing intensity of tillage operations. Conventional tillage produced 30.6% and reduced tillage recorded 10.2% higher seed yield than and zero tillage. The highest seed yield increase was recorded under conventional tillage followed by reduced tillage and zero tillage. Increasing the frequency of irrigation, the seed yield (kg ha^{-1}) of mustard improved markedly and significant increase in yield with increase in irrigation levels to three irrigations over the control. Application of one irrigation, two irrigations and three irrigations recorded 7.8, 18.6% and 24.2% higher yield as compared to the control.

Oil content (%) and Oil yield (kg ha^{-1})

Data presented in table 1 revealed that increasing intensity of tillage resulted in corresponding decrease in oil content from zero tillage to conventional tillage. And, the increase in seed oil content was significant between zero tillage and reduced tillage and reduced tillage and conventional tillage. Also increasing the frequency of irrigation increased the seed oil content (%) of mustard. The differences were significant between all the frequencies of irrigation.

The tillage practices resulted marked improvement in oil yield that increased significantly with increasing the intensity of tillage operations. The maximum oil yield of 596kg ha^{-1} was obtained with conventional tillage that recorded 7% and 16% higher oil yield than reduced tillage and zero tillage. As regards the irrigation application, oil yield of mustard improved significantly with increasing the frequency of irrigation application from no irrigation to subsequent levels of irrigations upto three irrigations.

Oil content of seed was decreased with increasing the intensity of tillage operations from zero tillage to conventional tillage (Table 1). However, the increase in seed oil content was significant between zero tillage and reduced tillage and reduced tillage and conventional tillage. The maximum seed oil content under zero tillage is attributed to the adequate availability of nutrients particularly that of sulphur from the organic residues retained on the surface in zero tillage after decomposition. Similar results have been reported by Sharief and Keshta (1999) and Sharma *et al.* (2006) [11]. The improvement in seed oil content with zero tillage might be due to the role of sulphur from organic matter decomposition in the formation of acetyl Co-A, a precursor compound for synthesis of long chain fatty acids. Besides this sulphur is the constituent of a multi enzyme complex "fatty acid synthatase'' that plays an important role in oil synthesis. Increased oil yield accompanied with higher seed yield with conventional ultimately enhanced the oil yield although the seed oil content was low was due to higher yields of seed (Table1). Similar findings were reported by Ghosh and Chatterjee (1986) and Ghosh (1994) [3].

Table 1: Effect of tillage practice and irrigation frequency seed oil, oil yield, protein content and protein yield of mustard

Treatment	Seed yield (kg ha^{-1})	Seed oil (Per cent)	Oil Yield (kg ha^{-1})	Seed Protein (Per cent)	Protein Yield (kg ha^{-1})
Tillage practices					
Zero tillage	1465	38.41	505.23	19.66	263.20
Reduced tillage	1615	37.45	558.52	19.76	282.69
Conventional tillage	1914	36.54	595.38	19.86	307.89
SEm±	72	0.04	2.77	0.01	0.59
CD (P=0.05)	215	0.11	6.95	0.02	1.74
Irrigation frequency					
Zero irrigation	1477	37.13	532.08	19.71	275.36
One irrigation	1591	37.30	544.88	19.74	281.84
Two irrigations	1753	37.56	561.04	19.77	287.54
Three irrigations	1837	37.86	574.18	19.81	293.63
SEm±	25	0.03	1.22	0.00	0.58
CD (P=0.05)	71	0.08	3.63	0.01	1.55

Protein content in seed (%) and Protein yield (kg ha^{-1})

Scrutiny of the data revealed marked effect of different tillage practices on the protein content of mustard seed. Increasing intensity of tillage from zero tillage to conventional tillage correspondingly enhanced the seed protein content. There was significant improvement in seed protein content was noticed between different treatments. As regards the irrigation frequency, protein content of mustard seed improved with increasing the frequency of irrigation application from no irrigation to three irrigations. Application of one, two and three irrigations recorded significantly higher seed protein content than control. The data on protein yield (kg ha^{-1}) as influenced by different tillage practices are presented in Table 1. It is apparent from the data that the different tillage practices influenced seed protein yield. Increasing intensity of tillage from zero tillage to conventional tillage caused significant increase in protein yield. All the tillage practices differed significantly in respect of seed protein content. It is also clear from the data that with regards to irrigation frequency, the protein yield (kg ha^{-1}) of mustard improved with increase in irrigation frequency up to three irrigations. All the irrigation frequencies differed significantly in respect of protein yield. Seed protein content of mustard was also increased with increasing tillage intensity up to conventional tillage (Table 1).Increasing intensity of tillage from zero tillage to conventional tillage correspondingly enhanced the seed protein content. There was significant improvement in seed protein content was noticed between different treatments. This could be ascribed mainly to the greater availability of nitrogen and sulphur at higher tillage intensity due better soil properties and better root growth growth as there exists direct relationship between nitrogen content and protein content in plants and sulphur is a constituent of three amino acids viz. cysteine, cystine and methionine. The protein yield is the resultant effect of seed yield and protein content. Therefore, the higher protein yield with increasing intensity of tillage operations is justified. These findings are in agreement with that of Ali *et al.* (2008).

Conclusion

The seed yield increased with increasing intensity of tillage operations. Conventional tillage produced 30.6% and reduced tillage recorded 10.2% higher seed yield than and zero tillage. Increasing the frequency of irrigation, the seed yield (kg ha^{-1}) of mustard improved markedly and significant increase in yield with increase in irrigation levels to three irrigations over the control. Application of one irrigation, two irrigations and three irrigations recorded 7.8, 18.6% and 24.2% higher yield as compared to the control. The maximum oil yield of 596kg ha^{-1} was obtained with conventional tillage that recorded 7% and 16% higher oil yield than reduced tillage and zero tillage. As regards the irrigation application, oil yield of mustard improved significantly with increasing the frequency of irrigation application from no irrigation to subsequent levels of irrigations upto three irrigations. Increasing intensity of tillage rom zero tillage to conventional tillage correspondingly enhanced the seed protein content. There was significant improvement in seed protein content was noticed between different treatments. As regards the irrigation frequency, protein content of mustard seed improved with increasing the frequency of irrigation application from no irrigation to three irrigations. Increasing intensity of tillage from zero tillage to conventional tillage caused significant increase in protein yield. The protein yield (kg ha^{-1}) of mustard also improved with increase in irrigation frequency up to three irrigations.

References

1. Arora VK, Gajri PR, Chaudhary MR. Effect of conventional and deep tillage on mustard for efficient water and nitrogen use in coarse textured soil. Soil and Tillage Research. 1993; 26(4):327-340.
2. Belal M. Effect of irrigation and sowing method on yield and yield attributes of mustard, Rajshahi University Journal of Life and Earth and Agricultural Sciences. 2013; 41:65-70.
3. Ghosh RK, Bandopadhyay P, Mukhopadhyay N. Performance of Rapeseed-mustard cultivars under various moisture regimes on the Gangetic Alluvial Plain of West Bengal, Journal of Agronomy and Crop Sciences. 1994; 173(1):5-10.
4. Jha BK, Kathju S, Vyas SP, Lahiri AN. Influence of irrigation and nitrogen levels on Indian mustard. Indian Journal of Plant Physiology. 2001; 6(3):289-294.
5. Kantwa SR, Meena NL. Effect of irrigation, phosphorus and PSB on growth and yield of mustard. Annals of Agricultural Research. 2002; 23(3):456-460.
6. Mandal BK, Saha A, Mara MC, Bhunia SR. Effect of zero and conventional tillage on winter oilseed crops in West Bengal. Soil and Tillage Research. 2008; 29(1):49-57.
7. Mondal N, Hossain S, Bhuiya S. Tillage and mulching effects on conservation of residual soil moisture, yield attributes and yield of mustard (cv. Daulat.). Bangladesh Journal of Agricultural Research. 2008; 33(4):597-606
8. Panda BB, Shivay YS, Bandyopadhyay SK. Growth and development of Indian mustard (*Brassica juncea*) under different levels of irrigation and dates of sowing. Indian Journal of Plant Physiology. 2004; 9(4):419-425
9. Parihar SS. Influence of N and irrigation schedule on yield, water use and economics of summer rice, International Journal of Tropical Agriculture. 2001; 19(4):157-162.
10. Parmar BS, Patel MM, Patel JC, Patel DM, Patel GN, 2016, "Enhance mustard [*Brassica juncea* (L.) Czern and Coss] productivity through sprinkler irrigation under north Gujarat conditions, Plant soil and environment. 2001; 87:62-68
11. Piri I, Sharma SN. Physiological analysis of growth and yield of Indian mustard as influenced by irrigation and sulphur. Indian Journal of Plant Physiology. 2006; 11(3):253-260.
12. Piri I, Sharma SN. Effect of sulphur on yield attributes and yield of Indian mustard (*Brassica juncea*) as influenced by irrigation. Indian Journal of Agricultural Sciences. 2007; 77(3):188-190.
13. Rajput RS, Karauria BS. Effect of Different Varieties and Irrigation Schedules on Yield of Mustard Bhartiya Krishi Anusandhan Patrika. 2010; 25(1):45-51
14. Rathore AL, Pal AR, Sahu KK. Tillage and mulching effects on water use, root growth and yield of rainfed mustard and chickpea grown after lowland rice, Journal of Science of Food and Agriculture. 1999; 78(2):149-161.
15. Saha D, Bohra JS, Shukla DN. Effect of N, P, S on growth attributes and nutrient uptake of mustard, Crop Research. 2010; 31(1):234-236.
16. Saha S, Tomar RK, Sen U, Garg RN. Effect of tillage (conventional and zero) and residue management (incorporation, retention and removal) on soil physical properties vis-à-vis plant growth after 3 years of continuous maize (*Zea mays* L.)–Indian mustard

[*Brassica juncea* (L.) Czern. &Coss.] Sequence. Indian Journal of Agricultural Sciences. 2010; 80(8):56-62.
17. Singh MP, Singh GS. Response of Brassica species to different irrigation regimes. Indian Journal of Plant Physiology. 2014; 7(1):66-69.
18. Singh PK, Singh AK. Effect of Different Dates of Sowing and irrigation scheduling on Growth and Yield of Mustard (*Brassica juncea* L.), Journal of Progressive Agriculture. 2014; 5(2):18-21
19. Teng Hongfel, Tan, Shilong, Tang Anyu. The growth characteristics of no tillage rape and its high yielding cultivation techniques in a hilly region. Jiangsu Agriculture Science. 1997; 6:31-33.