EFFECT OF PHYLLOSPHERIC BACTERIA ON INDIAN MUSTARD

S. MAITI, S. LAHA and B.N. CHATTERJEE

Department of Agronomy, Bidhan Chandra Krishi Viswavidyalaya, Kalyani, India, 741 235

SUMMARY

To study the effect of phyllospheric micro-organism ($KUPBR_2$ and KUP_4) as compared to the applications of 0,40 and 80 kg N/ha, with and without a growth regulator triacontanol on the growth and yield of Indian mustard (Brassica juncea Linn.) field experiments were conducted for two seasons. The pooled analysis of the results revealed that the responses of the crop to nitrogen were 11.72 and 8.66 kg oilseed per kg N/ha at 40 and 80 kg N/ha respectively. The mean increase in oilseed yields due to the spraying of phyllospheric micro-organism over the control treatment was 63 % as against 73 % recorded at 40 kg N/ha. The phyllospheric microorganism also increased the nitrogen content of plants and oil content in seed. High doses of nitrogen reduced oil content of seed and increased the nitrogen content. There was a close positive correlation of oilseed yield with leaf area duration ($r = 0.99$) and pod volume index ($r = 0.96$). Triacontanol did not show any significant advantage.

INTRODUCTION

Efforts are now being made to search out some atmospheric nitrogen fixing bacteria of non-symbiotic nature which can substitute for fertilizer nitrogen (Nandi and Sen, 1981). Ruinen (1956 and 1975) reported the occurrence of several N_2-fixing micro-organisms in the phyllosphere of a variety of tropical plants. However, the contribution, if any, of these organisms to the nitrogen nutrition of host plants has not been assessed adequately under field condition. Mustard (Brassica juncea Linn.)is an important oilseed crop in India and needs about 140 kg N/ha to obtain high yields (Roy et al. 1981). In this study, an effort has been made to analyse the growth and yield potentiality of Indian mustard under varying levels of nitrogenous fertilizer as compared to the spraying of some non-symbiotic nitrogen fixing phyllospheric bacteria, with and without a growth regulant chemical.

MATERIALS AND METHODS

Field experiments were conducted during winter (November - February) seasons of 1980-81 and 1981-82 at the University farm, Kalyani at 23.5°N latitude, 89°E longitude and 9.75 m altitude, were laid out in randomised block design in 3 replicates with 10 treatments as in Table 1, in an upland leached sandy loam Antisol soil of pH 7.40, available N 0.05%, P 29 kg/ha and K 115 kg/ha, in 6 m x 2.5 m plots. The variety 'Varuna' was sown in drills 30 cm apart and was fertilized at 40 kg P_2O_5 and 20 kg K_2O/ha. Nitrogenous fertilizer as per treatment was applied in the form of urea in two splits 20 and 34 days after sowing. The active strains of Klebsiella sp., $KUPBR_2$ and KUP_4 originally isolated from the phyllosphere of rice and cucurbit plants, respectively, were obtained from Dr. S.P. Sen, Professor of Botany, University of Kalyani, West Bengal. Isolation of phyllospheric N_2-fixing micro-organisms was based on the suggestions of Dickinson (1971) and Beech and Davenport (1971). Cultures exhibiting distinct turbidity after seven transfers were subjected to dilution plating in Burk's N-free agar medium. The colonies developed were selected at random, checked for purity with a light microscope and maintained on Burk's medium containing 0.025 % yeast extract.

The cultures were sprayed on the plant twice, usually at fortnight intervals. The first spray was done at 15 days after sowing, with about 5 ml of culture/plant.

Triacontanol (1-hydrowyl triacontane) a naturally occurring long chained aliphatic alcohol supplied by NOCIL, India, was sprayed twice, 21 and 42 days after sowing, at the rate of 200 ml in 500 litres of water per hectare.

RESULTS AND DISCUSSION

In the short and mild winter conditions of West Bengal the floral buds in 'Varuna' appeared 36 days after sowing and 50 % of flowering occurred 56 days after sowing.

Dry matter accumulation : Maximum dry matter yield was observed at 80 kg N/ha with spraying of triacontanol (Table 1). Effect of spraying $KUPBR_2$ or KUP_4 on dry matter accumulation was very similar and was lower than the effect of application of 40 kg N/ha.

Leaf area duration (LAD) : From flowering to 10 days before maturity (Table 2), LAD was least in plants growing in control plots. It was maximum (43.70 days duration) at 80 kg N/ha + spraying with triacontanol. The effect of two types of phyllospheric micro-organisms was very similar. The oilseed yield/ha showed close correlationship with leaf area duration ($r = 0.99$).

Pod volume (cc/m^2) index (PAI) : The highest PAI i.e. volume of pods/unit area of land surface was recorded where 80 kg N/ha was applied alongwith spraying of triacontanol. The PAI increased with increasing doses of N and it was closely correlated with oilseed production ($r = 0.96$). The spraying of either $KUPBR_2$ or KUP_4 appreciably increased the PAI over the plants growing in the control plot.

Number of siliqua/m^2 : Application of 80 kg N/ha along with spraying of triacontanol caused the production of maximum number of siliqua/m^2 followed by the treatment receiving 80 kg N alone. The spraying of phyllospheric organisms also appreciably increased the number of siliqua over the plants in control treatment.

Number of seeds per siliqua : This increased due to the application of N. Spraying of $KUPBR_2$ or KUP_4 bacterial cultures also increased the number of seeds/siliqua, similar to the effect caused by the application of 40 kg N/ha.

Test weight of seed : The test weight of seeds increased by the spraying of phyllospheric micro-organism and this was very much comparable to the plants receiving 80 kg N/ha.

Oilseed yield : The response was 11.7 kg and 8.7 kg of oilseed per kg of nitrogen at 40 and 80 kg N/ha, respectively. The benefit cost ratios were as high as 8.8 and 3.7 at 40 and 80 kg N/ha, respectively. Mean yield of the crop sprayed with $KUPBR_2$ and KUP_4 (1,047 kg/ha) was slightly lower than the yields recorded at 40 kg N/ha. The mean increase in yields due to spraying of phyllospheric micro-organisms over the control treatment was 62 % as against 73 % through the application of 40 kg N/ha. Nandi (1979) reported the increment of grain yield was 21 and 25 % due to phyllospheric bacteria and due to fertilizer N as urea, in pot experiments.

Oil and nitrogen content in plant : Spraying of phyllospheric micro-organisms increased oil percentage by 2.17 % and N content in plant by 1.63 % over those recorded at 40 kg N/ha. Nandi (1979) reported 23 % increase in oil content with spraying of $KUPBR_2$ and 46 % with KUP_4 strains of bacteria, as against 25 % with urea.

REFERENCES

Nandi, AS. (1979). Studies on nitrogen fixing micro-organisms. Some aspects of the possibilities of agricultural exploitation of biological nitrogen fixation. Ph. D. Thesis, University of Kalyani, Kalyani.

Nandi, A.S. and Sen, S.P. (1981). Utility of some nitrogen fixing micro-organisms in the phyllosphere of crop plants. Plant and Soil, 63 : 465-476.

Roy Vidyapati, Maiti, S. and Chatterjee, B.N. (1981) Growth analysis and fertilizer response of 'Varuna' Indian mustard. Indian J. agric. Sci. 51 (3) : 173-80.

Ruinen, J. (1956). Occurrence of Beijerinckia species in the Phyllosphere. Nature, London 177, 220-221.

Ruinen, J. (1975). Nitrogen fixation in the Phyllosphere In. Nitrogen Fixation by free-living micro-organisms. Ed. W.D.P. Stewart. Cambridge University Press. pp. 85-100.

Table 1. : Effect of fertilizer treatments on dry matter accumulation, leaf area duration and pod volume index of Indian mustard (Pooled mean of 1980-81 and 1981-82 seasons).

Treatments	Dry matter accumulation at harvest gm/m^2)	Leaf area duration from flowering to 10 days before maturity (days)	Pod volume index (cc/m^2)
Control	305	16.6	1,230.6
Spraying $KUPBR_2$	452	24.8	1,893.1
Spraying KUP_4	468	24.8	1,968.9
Spraying media	402	21.6	2,091.0
Spraying triacontanol	406	20.1	2,157.7
40 kg N/ha	503	29.6	2,187.5
80 kg N/ha	512	34.0	2,451.8
40 kg N/ha + triacontanol	516	31.6	2,314.7
80 kg N/ha + triacontanol	538	43.7	2,652.7
Treatments			
S.EM ±	20.0	4.45	5.47
L.S.D. (0.05)	46.0	10.19	18.32
Year			
S.Em ±	50.0	2.09	2.58
L.S.D. (0.05)	114.5	4.79	5.91

Table 2 : Effect of fertilizer treatments on the yield, yield components, oil and nitrogen contents in oilseeds (pooled mean of 1980-81 and 1981-82 seasons).

Treatments	No. of siliqua per m^2	No. of seed/ siliqua	Test weight 1000 seed wt. in gm.	Oilseed yield kg/ha	Per cent oil in oil-seed*	Percent N in plant**
Control	4,350	10.5	3.51	644.5	31.83	1.04
$KUPBR_2$	4,405	12.0	3.66	1,073.5	33.80	1.72
KUP_4	6,870	11.0	3.76	1,021.0	34.15	1.55
Media	6,400	11.5	3.50	785.0	32.88	1.07
Triacontanal	5,895	11.0	3.53	739.5	35.30	1.39
40 kg N/ha	7,120	11.5	3.54	1,113.5	31.61	1.17
80 kg N/ha	8,920	12.5	3.68	1,337.5	31.52	1.22
40 kg N/ha + Triacontanol..	8,260	12.0	3.74	1,171.0	33.62	1.51
80 kg N/ha + Triacontanol.	10,740	12.0	3.57	1,341.0	32.67	1.45
Treatments						
S. Em ±	770	0.38	0.073	73.5		
L.S.D. (0.05)	1,760	0.88		168.3		
Year						
S.Em ±	360	0.18	0.030	34.0		
L.S.D. (0.05)	824	0.42	0.069	77.9		

* *Petroleum ether extraction in Soxhlet's apparatus ;*

** *Kjeldahl method.*