EVALUATION OF QUALITY GENOTYPES OF *OLEIFEROUS BRASSICA* UNDER DIFFERENT SOURCES AND LEVELS OF NUTRIENT AND THEIR RESIDUAL EFFECT ON SUCCEEDING COWPEA (*VIGNA UNGUICULATA* (L.) WALP)

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ABSTRACT

A fixed plot field experiment was conducted at the Research Farm, Agronomy Division, Indian Agricultural Research Institute, New Delhi during 2005-06 and 2006-07 to evaluate quality genotypes of *Oleiferous brassica* for the productivity, oil content, protein content, glucosinolate content, fatty acid composition, nutrient content and uptake, heavy metals content and uptake, nutrient use efficiency and economics of production under different sources of nutrients and S levels and residual effects of the treatments given to *Brassicas* on the succeeding crop of cowpea.

Treatments comprises of three genotypes of *Oleiferous brassica viz*., 'Pusa Mahak' (non-canola, 'Pusa Krishma' (Semi-canola having zero erucic acid) and 'GSC 3A' (Canola having zero erucic acid and glucosinolate content), four levels of sources of nutrients *viz*., control, recommended dose of NPK through inorganic, recommended dose of nitrogen through organic (FYM) and half of recommended dose of NPK through inorganic + half of recommended dose of nitrogen through organic and two levels of sulphur *viz*., control and 40 kg S/ha. A fixed plot field experiment was carried out in three times replicated split-split plot design. Main plots of the design received three genotypes of *brassicas*, while sub-plots and sub-sub plots received four levels of nutrient sources and two levels of sulphur, respectively.

The soil of experimental site is sandy loam in texture. Water table remained below 3.5 meter deep from ground surface during crop growth period. The composite representative soil sample was collected from the experimental field prior to experimentation and based on the analysis for available nutrients, composite sample of soil was found to contain 182 kg N, 13.4 kg P, 220 kg K and 12.2 kg S/ha of macronutrients and 15.2 ppm Fe, 5.48 ppm Zn, 4.16 ppm Cu and 4.71 ppm Ni of heavy metals. The initial values of soil pH, soil organic carbon content and bulk density were found 7.73, 0.38 and 1.47, respectively. The *brassicas* genotypes and succeeding cowpea were grown following recommended cultivation practices except the variation in treatments. The oil content in rapeseed-mustard seed was estimated by Pulse Nuclear Magnetic Resonance (NMR) Technique (Tiwari and Burk, 1980). Protein content (%) in seed was calculated by multiplying the nitrogen per cent in seed by the factor 6.25 (A.O.A.C., 1960). Glucosinolate determination was done by using High-Performance Liquid Chromatography (HPLC), whereas fatty acid compositions of oil by Gas Chromatography (GC). N concentration in the plant samples was determined by macro Kjeldahl method (Jackson, 1967); the phosphorus concentration in the digest was estimated by Vanadomolybdo phosphoric yellow colour method with the help of Spectrophotometer (GS 5702, Electronic Ltd.) at 470 mm wave length (Jackson, 1967); potassium concentration in digest was determined by using Flame photometer (Model CL-22D Elico Pvt. Ltd.) and sulphur concentration in the digest was determined by turbidimetric method (Chesnin and Yien, 1950) with Spectrophotometer (GS-5702, Electronics Corporation of India Ltd.). Fe, Cu, Zn, Pb, and Ni concentration of different parts of plant of *Brassica species* samples was determined with the help of Atomatic Absorption Spectrophotometer (AAS) (Tandon, 1995).

The uptake of nitrogen, phosphorus, potassium and sulphur (kg/ha) and heavy metals (g/ha) in each component was calculated by multiplying the nutrient concentration (%) and dry matter yield (kg/ha) of various components under different treatments of crops and values of uptake so obtained were pooled to work out the total removal from the soil by each crop and cropping system. Microbial activity in terms of fluoresein diacetate (FDA) hydrolysis in soil was measured by procedure described by Green *et al*. (2006). Dehydrogenase activity of soil samples was estimated by the method described by Casida *et al*. (1964). Microbial biomass carbon in soil samples was estimated by the method described by Vance *et al* (1987) and Numan *et al*. (1998) derived a method for estimation of microbial biomass C.

'Pusa Mahak' (1.91, 2.24 t/ha) and 'Pusa Krishma' (1.80, 2.13t/ha) produced similar seed yield but both were significantly superior to GSC-3A (1.44, 1.45 t/ha). Biological yield was recorded the highest by 'Pusa Krishma' followed by 'Pusa Mahak', while the harvest index was noted maximum in 'Pusa Mahak' (25.6, 26.4), followed by GSC-3A. 'Pusa Krishma' recorded marked reduction in oil content, as a result, its oil yield recorded drastic reduction over 'Pusa Mahak'. Pusa Mahak' exhibited its superiority in terms of gross returns (Rs 32821, 38352 /ha) and net returns (Rs 17509, 22272/ha), followed by ''Pusa Krishma'. Both 'Pusa Mahak' and 'Pusa Krishma' had similar net B:C ratio, but both were significantly superior to 'GSC 3A'. Glucosinolate and erucic acid contents were recorded the highest in 'Pusa Mahak' and the lowest in 'GSC 3A'. 'Pusa Krishma' removed greater quantity of NPKS and heavy metals closely followed by 'Pusa Mahak'. Uptake of nutrients was appreciably low in 'GSC 3A'. 'Pusa Mahak' and 'Pusa Krishma' recorded similar agronomic N use efficiency, but both were superior to 'GSC 3A'.

In the first crop cycle of fixed plot experiment, integrated nutrient application to *brassicas* registered significant increase in seed, biological, and oil yields, uptake of NPKS and heavy metals, agronomic N use efficiency, gross and net returns and net B:C ratio followed by inorganic use of nutrients. In the second crop cycle, integrated use of nutrients maintained its superiority with respect to these parameters closely followed by organic use in place of inorganic use. Organic and integrated use of nutrients induced marked increase in oil, protein and glucosinolate content than inorganic use of nutrients.

Application of 40 kg S/ha was found to induce marked improvement in plant height, LAI, DMP, number of siliquae per plant (295, 348), 1000-seed weight (4.4, 4.5 g), seed yield (1.82, 2.04 t/ha), biological yield (7.48, 8.05), harvest index (24.1, 25.1), oil content (37.9, 38.0) and oil and protein yields over control. Effect of S application was also found positive on glucosinolate content during both the seasons. Changes in fatty acid composition due to S application were not found consistent over the study period.

Significant interactions between genotypes and nutrient sources and genotypes and sulphur levels were recorded with respect to seed and oil yields, glucosinolate content, fatty acid composition and nutrients and heavy metals uptake.

Cowpea after ''GSC 3A'' recorded the highest green pod yield, protein yield, gross and net returns and net B:C ratio. Green pod yield, protein yield, nutrient uptake, gross and net returns and net B:C ratio of cowpea cultivation found similar due to residual effect of organic and integrated use of nutrient sources during first crop cycle, while in the second crop cycle organic found better than integrated use, however both had significant edge over inorganic use of nutrients during both the seasons. Residual effect of S application was observed on green pod yield.

'Pusa Mahak'–cowpea (4.96, 4.95 t/ha) and 'Pusa Krishma'-cowpea (4.86, 4.90 t/ha) system produced similar mustard seed equivalent yield during both the crop cycles, but both the systems were superior to 'GSC

3A'-cowpea (4.54, 4.46 t/ha) system in terms of system productivity. In first crop cycle, mustard seed equivalent yield (5.78 t/ha) gross returns (Rs/ha 62500) and net returns (Rs/ha 49300) of system were observed significantly the highest due to direct and residual effect of integrated nutrient management, followed by organic use of nutrients. In the second crop cycle, the highest system productivity gross returns and net returns were recorded due to direct and residual effect of organic sources followed by INM. Due to direct and residual effect of S, mustard seed equivalent yield, gross returns, net returns and net B:C ratio, agronomic N use efficiency, physiological N use efficiency and N, P, K, S uptake exhibited marked increase over control.

Organic and integrated application of nutrients had favourable effects on soil health in terms of available nutrients balance, soil pH, soil organic carbon, bulk density and microbial properties of soil as compared to inorganic use, control and initial values.

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