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Review of research on INM and various weed control practices in rice (*Oryza sativa* L.)- Groundnut (*Arachis hypogaea* L.) cropping system under irrigated medium land situation

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Abstract

Rice-groundnut cropping system is one of the important cropping systems of India. Rice (*Oryza sativa* L.) is the staple food of the world. Rice is a heavy nitrogen feeder, but fertilizer nitrogen use-efficiency is very low under tropical conditions. Nutrient management provides an approach for feeding the plants with nutrients as and when required. It is therefore, necessary to apply fertilizer elements particularly N, P and K in optimal quantity to increase and sustain the productivity. A major portion of nitrogen in wetland soils occurs in organic pool, though this is usually low. Complementary use of organic and biological source of plant nutrient along with chemical fertilizer is of great importance for the maintenance of soil health and productivity. Sustainable cropping systems require crop yields should be stable through the maintenance of soil fertility and the balance of nutrients in the system. Increases in soil carbon levels require sustained periods of balanced fertilization and residue retention. Weed infestation in rice remains the largest constraint, limiting its productivity. Groundnut (*Arachis hypogaea* L.) is one of the most important edible oilseed crop extensively cultivated in the world. This groundnut is highly susceptible to weed infestation because of its initial slow growth habit up to 40 days after sowing, short plant height and underground pod bearing habit. In this review studies on the effect of integrated nutrient management and weed control practices on rice (*Oryza sativa* L.) – groundnut (*Arachis hypogaea* L.) cropping system are discussed. Judicious application of chemical fertiliser coupled with green manuring of *Dhaincha* and use of herbicides in rice as well as succeeding groundnut crop for management of weeds increases the productivity of the system.

Keywords: Integrated nutrient management, weed management, cropping system

Introduction

Rice feeds fifty percent of the world population and shares nineteen percent of the global calories intake (IRRI, 2014) [20]. Rice is grown in 112 countries of world covering every continent. India has the largest area under rice cultivation in the world and shares 17.9% of world's rice production and occupies second position next to China. Rice is cultivated in diverse ecologies spread over 42.7 million ha during 2012-13 with a production of 105.3 million tonnes of milled rice with average productivity of 2462 kg/ha (MOA, GOI, 2015) [36]. By the year 2050, the world needs 8-10 million tonnes more rice each year to meet people's needs (Patra, 2013) [17]. Though eastern India occupies 61.3% of the rice area of the country (27 million ha), it contributes only 48% of the total rice production and it has much lower growth rate of rice yield compared to other regions of the country (Mahapatra, 2013). Hence, research initiatives are imperative in this area to address the production constraints and coming up with suitable solutions. Rice crop and rice based cropping systems are essential to everyone directly for food security and livelihood improvement. Several abiotic stresses (deficit moisture stress in uplands, excess moisture stress in lowlands, salinity problem in coastal areas, cloudy sky) and biotic stresses (disease and pest attack, weed infestation) coupled with poor crop management practices lead to lower average productivity of rice. Integrated use of organic manures and chemical fertilizers has advantages over use of only organic manures or chemical fertilizers (Kumar *et al.*, 2009). Since sourcing of organic manure is difficult and the crop response to them during initial stages is not as spectacular, compared to the chemical

fertilizers (Deka *et al.*, 1996), an integrated approach of plant nutrition involving the judicious mix of organic and chemical could be helpful to sustain optimum yield and to restore the residual soil fertility. Out of the organic sources available for use in rice production, farmyard manure is the proven source of nutrition, but its availability is quite inadequate (Mishra and Prasad, 2000) [43]. This necessitates searching for organics such as green manuring and use of biofertiliser. A weed free period for the first 30-45 days after transplanting is required to avoid any loss in yield, because the dry weight of weeds increases greatly from 30 DAT in transplanted rice. Groundnut (*Arachis hypogaea* L.), also known as peanut, is a legume that ranks 6th among the oilseed crops and 13th among the food crops of the world. Groundnut is grown on 23.95 million ha worldwide with the total production of 36.45 million tons and an average yield of 1520 kg/ha in 2009 (FAOSTAT 2011). Groundnut plays a significant role in the livelihoods of smallholder farmers. Late harvesting of rice crop, particularly in northern and eastern parts of the country delays the sowing of succeeding oilseeds resulting in lower crop yield and input use efficiency (Mishra and Singh, 2011) [22]. Since, rice-groundnut cropping system is the important cropping system in East and South Eastern plain zone of Odisha, in-depth studies in on integrated nutrient management approaches and weed control practices in rice and weed control in succeeding *rabi* groundnut crop is of paramount importance for higher productivity of the system.

Effect of INM and Weed management practices on weed flora of rice

The weeds viz. *Cynodon dactylon*, *Chloris barbata*, *Dactyloctenium aegyptium*, *Digitaria sanguinalis*, *Echinochloa colona*, *Eleusine indica* and *Panicum repens* among the grasses; *Alternanthera sessilis*, *Cleome viscosa*, *Eclipta alba*, *Euphorbia hirta*, *Ludwigia parviflora*, *Parthenium hysterophorus*, *Phyllanthus niruri*, *Portulaca oleracea* and *Tridax procumbens* among the broad leaved weeds, *Cyperus rotundus* and *Cyperus siria* among the sedges were reported to be the major weed flora of aerobic rice from different parts of India (Moorthy and Saha 2002 and Ramesh *et al.* 2009) [38]. The major weed species found in the experimental field of rice were *Echinochloa colonum*, *Panicum repens*, *Paspalum distichum*, *Cynodon dactylon* among grasses. *Cyperus difformis*, *Cyperus siria*, *Scirpus supinus*, *Fimbristylis dichotoma* among sedges and *Caesulia axillaris*, *Eclipta alba*, *Ammania baccifera* among broad leaved weeds (Bhanu Rekha *et al.*, 2004) [3]. Subramanian *et al.* (2004) found that grasses like *Echinochloa colonum* (L.), *Echinochloa crus-galli* (L.), and *Cynodon dactylon* (L.); Sedges like *Cyperus rotundus* (L.), *Cyperus siria* (L.), *Cyperus difformis* (L.) and *Fimbristylis miliacea*; and broad-leaved weeds like *Eclipta alba* (L.), *Ammania baccifera* (L.), *Ludwigia parviflora* (L.) and *Phyllanthus niruri* (L.) were the major weeds in drum seeded rice under puddle condition on sandy clay loam soils of Madurai, Tamilnadu. Saha (2005) observed that *Echinochloa colonum* (L.), *Cyperus siria* (L.), *Fimbristylis miliacea*, *Scirpus articulatus* (L.), *Panicum repens* (L.), *Leptochloa chinensis* (L.), *Sphenocleazeylanica* (L.), *Ludwigia parviflora* (L.), *Aeschynomene indica* (L.), *Limnophilaheterophylla* (L.), *Cleome viscosa* (L.) and *Monochoriavaginalis* (L.), *Melochiacorchorifolia* (L.), were the major weeds infesting rice in direct-sown rainfed lowland rice in Cuttack, Odisha. Important weed flora observed on sandy loam soils of Crop Research Station, Ghaghraghat, Bahraich, Uttar Pradesh were

Fimbristylismiliacea, *Cyperusrotundus* (L.), *Leptochloachinensis* (L.), *Cyanotis axillaries*, *Alternantherasessilis*, *Commelinabenghalensis* (L.) (Singh *et al.* 2008). Chaudhary and Gangwar (2011) [12] revealed that *Echinochloacrusgalli*, *Cyperusiria*, *Cyanotisspp*, *Scirpuspp* and *Ageratum conyzoides* are the major weed flora in puddle seeded rice in Palampur, Himachal Pradesh. In wet direct seeded rice *Echinochloa colonum*, *Echinochloacrusgalli*, *Eleusineindica*, *Cyperusrotundus*, *Cyperusiria*, *Fimbristylismiliacea*, *Amaranthusviridis*, *Ammani abaccifera* and *Caesuliaaxillaris* were the dominant weed flora. Yadav and Singh (2006) reported *Cynodondactylon*, *Cyperusrotundus* (L.), *Cyperusiria*, *Echinochloacrusa-galli*, *Echinochloa colonum*, *Fimbristylisdichotoma*, *Phyllanthusniruri* were the major weeds in transplanted rice at Faizabad, Uttar Pradesh. Saha (2006) [51] observed that *Echinochloa* spp (14.3 percent), *Cyperusiria* (25.3 Percent), *Fimbristylismiliacea* (20.9 percent), *Sphenocleazeylanica* (12.1 percent) and *Ludugiaparviflora* (9.8 percent) were the major weeds in transplanted rice Cuttack, Odisha. Halder and Patra (2007) [17] reported the weed flora in transplanted rice on sandy loam soils of Chipilima, Odisha constituted grasses, viz., *Digitariasanguinalis* (L.) Scop., *Echinochloacrusgalli* (L.), *Echinochloa colonum* (L.), *Panicumrepens* (L.), *Cynodondactylon* (L.) Pers; sedges, viz. *Cyperusrotundus* (L.), *Cyperusiria* (L.), *Cyperusdifformis* (L.), *Fimbristylismiliacea* (L.) Vaha; and broad leaved weeds viz. *Ammaniabaccifera* (L.), *Ludugiaparviflora* (L.), *Ecliptaprostrata* (L.), *Eclipta alba* (L.), *Marsileaquadrifolia* (L.) and *Commelinabenghalensis* (L.). The major weeds in transplanted rice were *Cyperusiria* (L.), *Cyperusdifformis* (L.), and *Fimbristylislittoralis* and broad leaf weeds of semi aquatic nature, including *Ludugiaparviflora* (Bhowmick and Ghosh, 2008) [5]. Among the total weed population at 30 days in transplanted rice, grasses (*Echinochloacrusgalli* L.) constituted 16.9 percent, sedges (*Cyperusiria* L. and *Fimbristylismiliacea* L.) 47.0 percent and broad leaf weed (*Ludugiaparviflora* L., *Commelinabenghalensis* L. and *Sphenocleazeylanica* L.) 36.1 percent of the total weeds population on clay loam soils of Cuttack (Saha, 2009) [52]. Yadav *et al.* (2009) found that transplanted rice field was infested with 85 percent of grasses like *Echinochloa colonum* (L.), *Echinochloa glabrescens* (L.), 8 percent of broad leaved weeds like *Euphorbia* sp. and *Ammaniabaccifera* L. and 7 percent of sedges like *Cyperusrotundus* (L.), *Cyperusiria* (L.) and *Cyperusdifformis* (L.) in transplanted rice on clay loam soils of Karnal, Haryana. Khare *et al.* (2014) reported some dominant weed flora distributed were *Echinochloa crus-galli* (L.), *Echinochloa colonum*, *Leptochloachinensis* (L.), *Eclipta alba* (L.) and *Cyperusdifformis* (L.), distributed in experimental plots under transplanted rice, New Delhi.

Effect of INM and IWM of rice on weed density and weed drymatter production of weeds

Manual weed control is rapidly being replaced by chemical weed control in many Asian countries (Malsunaka, 1983) [34]. Thus effective weed control often requires a combination of cultural, mechanical and chemical control such as an integrated weed management approach to delay herbicide resistance and reduce the herbicide load in the agro-ecosystem (Rao *et al.*, 2007 [50] Subbulakshmi and Pandian (2002) [46], Halder and Patra (2007) [17] and Singh and Singh (2010) reported less weed dry weight and weed density with line transplanting as compared to drum seeding method due to less weed growth under submerged condition of transplanted rice.

Gogoi *et al.* (2000) and Kolhe (1999) reported hand removal of early emerged grassy weeds and sedges along with the broad leaved species lowered the accumulation of dry matter by weeds and these resulted in better crop growth which in turn smothered the weed growth in comparison to other treatments. These resulted in higher weed control efficiency under other treatments. Raju and Pandian (2001) [46] reported hand weeding twice at 30 and 45 DAS controlled weeds efficiently with WCE of 93.95% and weed dry weight of 10.7 kg/ha as compared to two mechanical weeding (86.2% and 24.25 kg/ha) under wet-direct seeded rice condition. Among the different weed control methods, adoption of cultural + manual weeding was the most effective in restricting the total weed population (22.41 and 41.63/m²) and it also resulted in the lowest weed dry weight (15.7 and 36.8 g/m²) and the highest weed control efficiency (83.3 and 74.6%) during both *kharif* and *rabi* seasons, respectively. This may be due to combined action of the maximum weed removal from inter and intra row space of crop by manual weeding and smothering effect of green manuring crop (Bayan and Kandasamy, 2002). Halder and Patra (2007) [17] reported two hand weeding at 20 and 40 DAT recorded the minimum weed population, dry weight of 18.7/m², 16.0g/m² and 86.1% as compared to other chemicals applied to crop. At harvest, transplanting recorded significantly the lowest weed biomass of 31.4g/m² followed by direct seeded broadcasted rice with weed biomass of 35.5g/m² (AICRP on weed control, 2010) [10].

Weed density and weed dry matter affected by application of bispyribac sodium

The post emergence application of bispyribac sodium at 25 and 30 g a.i/ha in dry seeded rice resulted in lesser weed population and weed dry weight (2.7 and 2.2 q/ha respectively), resulting in higher weed control efficiency, lower weed index and produced significantly higher grain yield (56.19 and 58.23 q/ha) over unweeded control (Walia *et al.*, 2008). Christors *et al.* (2008) reported that bispyribac sodium (24 to 36 g a.i/ha) applied at 3 to 4 leaf growth stage provided 89-100% control of early water grassy weeds and 84-100% control of late water grassy weeds. Pendimethalin 1.0kg/ha followed by bispyribac sodium 0.025kg/ha recorded the lowest weed index of 1.56% followed by application of oxadiargyl 0.1kg/ha followed by bispyribac sodium 0.025kg/ha under direct seeded rice condition (AICRP weed control, 2012). Nalini *et al.* (2011) observed that application of Bispyribac sodium 40 g/ha registered lower weed density and dry weight of weeds and it was followed by Bispyribac sodium 20 g/ha. The same treatment also recorded higher weed control efficiency which resulted in higher grain and straw yield of transplanted rice. Veeraputhiran *et al.* (2012) suggested that higher economic benefits like net income and Benefit-Cost ratio were also associated with the application of Bispyribac sodium at 25 g/ha than all the other weed management treatments indicating suitable and economical herbicidal weed management for higher productivity in transplanted rice. Wallia *et al.* (2013) indicated that during 2007, integration of post-emergence application (30 DAS) of bispyribac sodium (25 and 30 g/ha) or azimsulfuron (20 g/ha) with pre-emergence application of pendimethalin 0.75 kg/ha, pretilachlor 0.5 kg/ha and thiobencarb 1.25 kg/ha provided effective control of weeds and produced significantly higher grain yields than unweeded (control) treatment.

Weed density and weed dry matter influenced by application of Oxadiargyl

Hasanuzzaman *et al.* (2009) reported that the grain yield produced by W7 (Top star 400 SP (Oxadiargyl 400 g/l) @ 90 ml/ha + 1 hand weeding at 25 DAT) and W3 (2 hand weeding at 25 and 50 DAT) was 104.90 and 92.65% higher than the yield obtained from un weeded control (W1). Wallia *et al.* (2013) indicated that during 2008 also, integration of pre-emergence application of pendimethalin 0.75 kg/ha or oxadiargyl 90g/ha with post emergence application of bispyribacsodium (25 and 30 g/ha) resulted in significant reduction in dry matter of weeds and increase in grain yield as compared to alone application of pendimethalin 0.75 kg/ha. The highest weed control efficiency, grain yield and benefit: cost ratio were recorded with sequential application of oxadiargyl 75 g ha⁻¹ and bispyribacsodium 30 g ha⁻¹ which were at par with HW twice at 20 and 40 DAT in transplanted rice (Kiran *et al.*, 2010). D. Jacob, Elizabeth K. Syriac (2005) reported that the weed flora consisting of *Echinochloa colona*, *Echinochloa crus-galli* and *Leersia hexandra* (grasses); *Cyperus iria*, *Cyperus difformis* and *Fimbristylis miliaceae* (sedges); and *Ludwigia parviflora* and *Monochoria vaginalis* (broad-leaf weeds), had considerably lower NPK uptake in the weed management treatments compared to unweeded plots.

Effect of INM and weed management practices on yield of rice

Singh *et al.* (2004) reported that transplanted rice recorded 40% higher grain yield as compared to broadcast rice under silty loam soil condition. Brar and Bhullar (2013) reported transplanted rice resulted in 10-12% higher biological yield as compared to direct sown rice. Ghasalet *et al.* (2014) reported transplanted rice recorded higher straw yield as compared to direct seeded rice, but they were at par with each other. Higher straw yield may be due to higher plant height at the time of harvest. Subramaniyam *et al.* (2006) and Singh *et al.* (2007) reported hand weeding twice recorded higher grain yield as compared to other herbicides applied in field. Paradkar *et al.* (1997) opined that hand weeding at 15-30 DAS controlled weeds effectively and produced 20% and 50% higher yield as compared to herbicide application and mechanical control of weed under upland direct seeded rice. Mann and Ashraf (2000) found that the maximum paddy yield could be obtained by either applying recommended dose of inorganic N fertilizer (80 kg ha⁻¹) or lowering its level to 40 kg ha⁻¹, when supplemented by green manure, *dhaincha*, (*Sesbania aculeata*). Yadav and Singh (2006) reported two hand weeding produced 19% higher straw yield as compared to herbicide followed by one hand weeding. Singh and Singh (2010) reported hand weeding at 20 and 40 DAS gave higher biological yield as compared to application of pendimethalin @ 1.0 kg/ha only. Brar and Bhullar (2013) reported hand weeding at 20 and 40 DAS gave higher straw yield as compared to pendimethalin applied @ 1.0 kg/h followed by bispyribac sodium @ 0.03 kg/ha.

Effect of INM and weed management practices on nutrient uptake by rice

Rana *et al.* (2002) [49] revealed that in puddled seeded rice, use of herbicides increased nutrient uptake. Uptake of nutrients was higher by rice with the application of butachlor @ 1.50 kg/ha (94, 20.55 and 113.60 kg N,P and K/ha, respectively)

and was as effective as hand weeding twice for nutrient uptake by rice crop. But in contrast, BhanuRekha *et al.* (2002)^[4] revealed that in transplanted rice uptake of nutrient by rice was higher with hand weeding twice at 20 and 40 DAS condition (88.4, 22.9 and 83.5 kg N, P and K /ha) than application of herbicides alone. Singh *et al.* (2005) and Singh and Singh (2010) reported hand weeding alone recorded higher nutrient uptake (50.2 kg.N/ha, 11.9 kg.P/ha and 10.1 kg.K/ha) as compared to weedy check and other chemical treatments under direct seeded condition. This may be due to less growth of weeds and better crop growth parameters. Payman and Singh (2008)^[40] and Sairamesh *et al.* (2011)^[56] reported that two hand weeding at 30 and 40 DAS in direct seeded upland rice recorded lower weed dry weight at harvest and higher N uptake by crops and lower N uptake by the weeds as compared to plots treated with herbicides. Manjunatha *et al.* (2012)^[33] observed that the higher uptake of N, P and K in crop (106.44, 16.32 and 111.86 kg/ha respectively) with post emergence application of bispyribac sodium @ 25 g a.i. kg/ha and this treatment was at par to pre-emergence application of bensulfuron methyl @ 60 g a.i./ha + pretilachlor @ 600 g a.i./ha.

Effect of INM on physical properties of soil

Ahmad *et al.* (1991) observed significant increase in soil organic carbon and total N by use of organic sources (cowpea or sunnhemp) of nitrogen over 2 years to rice crop in rice-wheat sequence was observed after harvest of first rice crop upto 3rd year following for one year. Singh (1994) a five year study on integrated nitrogen management revealed that organic C and available P and K contents were significantly increased by *Sesbania aculeata* than manure incorporation. Behera and Jha (1997)^[51] reported that on-farm participatory trials were conducted during rainy season of 1990 & 1991 in Kalahandi, Orissa, which revealed that adopting low cost technology for green manuring in rice with *Sesbania (Dhaincha)* raised the productivity of low land rice by nearly 1.0 t/ha rough rice (37% increase). Supplementing green manuring with moderate doses of 20 kg N ha⁻¹ (urea) at incorporation resulted in a further increase of 0.5 t ha⁻¹ of rough rice making it highly remunerative and acceptable to resource poor farmers at Kalahandi. Mann and Ashraf (2000) found that the maximum paddy yield could be obtained by either applying recommended dose of inorganic N fertilizer (80 kg ha⁻¹) or lowering its level to 40 kg ha⁻¹, when supplemented by green 10 manure (*dhaincha S. aculeata*). On the other hand, high rate of FYM (20 t ha⁻¹) in combination with lower N (49 kg ha⁻¹) also gave significant increase in paddy yield. FYM are scarce, whereas fast growing and short duration green manure crops like *dhaincha* can be easily grown during fallow period of 40-70 days after wheat harvest for improving soil physico-chemical properties and sustaining productivity of cereal crops in an experiment conducted in Pakistan. Saha *et al.* (2000) reported that green manuring (*dhaincha, S. aculeata*) treatment consisted of fallow, green manure (G.M.) alone, G.M. with 30 kg P₂O₅ at the time of sowing and GM with 30 kg P₂O at time of burying (50 days after sowing). These treatments were allotted in main plot in succeeding wheat cv. Kundan with 3 levels of P (0, 30 and 60 kg ha⁻¹) in sub-plot treatment. It was found that green manuring with 30 kg P₂O₅ at sowing followed by 60 kg P₂O₅ ha⁻¹ to wheat resulted in maximum net return of the sequence at IARI New Delhi. Ray and Gupta (2001) found that incorporation of *Sesbania aculeata* green manure before puddling of rice improved the soil aggregation and

significantly improved mean weight diameter under rice-wheat system. Saha *et al.* (2007) conducted 7-year long field trial on integrated nutrient management for a dry rice (Boro)-green manure (GM)-wet season rice (T. Aman) cropping system at Bangladesh during 1993-1999. They found that plant height, active tiller productions, grain and straw yields were significantly enhanced due to application of inorganic fertilizers and organic manure. This study showed that addition of organic manure (cowdung and *dhaincha Sesbaniaaculeata*) gave more positive balances. The application of cowdung and *dhaincha* green manure along with chemical fertilizers not only increased organic C, total N, available P and available S but increased exchangeable K, available Zn, available iron (Fe), and available manganese (Mn) in soil. Vennila and Jayanthi (2007) observed that application of 75% RDFN + organic manure resulted in higher soil available organic carbon, nitrogen and phosphorus. Application of 75% RDFN alongwith 25% N as organic manure to preceding wet seeded rice had significant residual effect on yield and nutrient uptake of succeeding green gram.

Effect of weed management practices on comparative economics / profitability of rice

Singh *et al.* (2008) observed that pre-emergence application of herbicide at 8 days in combination with either mechanical weeding or hand weeding twice on 30 and 45 days recorded the highest benefit cost ratio (3.44) and hand weeding twice at 30 and 40 days after sowing remained at par, with it. Veeraputhiran and Balasubramanian (2013)^[69] reported post emergence application of bispyribac sodium at 25 g a.i./ ha recorded the highest net profit (₹ 42452) and B: C (2.89) followed by bispyribac sodium at 35g a.i./ ha with net profit of ₹ 42,090 and B: C of 2.81.

Groundnut

The groundnut is highly susceptible to weed infestation because of its initial slow growth habit up to 40 DAS (days after sowing), short plant height and underground pod bearing habit. Groundnut weeds comprise diverse plant species from grasses to broad-leaf weeds and sedges and cause substantial yield losses (13–80%) Ghosh *et al.* (2001)^[14], Jat *et al.* (2011)^[22]

Weed flora in groundnut

Bhagavatha *et al.* (2015)^[2] reported that weed species found in the groundnut are *Cyperusrotundus* L among sedges,, *Digitariasanguinalis* among grasses, *Boerhaviaerecta*, *Cleome viscosa*, *Celosia argentia*, *Commelinabenghalensis*, *Digeraarvensis*, *Eclipta alba* and *Trichodesmaindicum* among broad leaf weeds.

Effect on groundnut

Vilas *et al.* (2012)^[68] reported complete weed free condition recorded highest dry pod yield (1786 kg ha⁻¹). This treatment increased shelling% and kernel weight. Pendimethalin @ 1.0 kg a.i./ha+1HW at 15 days after sowing increased nutrient uptake (85 kg N + 9 kg P₂O₅) as compared to weedy check (45 kg N + 2.8 kg P₂O₅) Yuvraj R. *et al.* (2012)^[74] reported that Pre emergence application of Pendimethalin 1.0 kg a.i./ha followed by one hand weeding at 15 days after sowing, recorded 10.8 pods/plant as against 4.97 pods/plant and 60.0 nodule per plant as against 37.5 in unweeded control. Pre-emergence application of Pendimethalin @ 1.0 kg a.i./ha followed by post emergence Imazethapyr @ 75 g a.i./ha at 15 days after sowing increased pod yield (1255 kg ha⁻¹),

shelling% and 100 kernel weight. Application of Pendimethalin recorded increased soil fungal count 16.0×10^4 cfu g-l, soil actinomycetes count 15.67×10^6 cfu g-l and soil bacterial count 20.33×10^7 cfu g-l, compared to unweeded control. Vilas *et al.* (2012) reported that Two hand weedings at 15 and 30 days after sowing were effective to reduce weed count and weed biomass, and increased WCE and thus increased developed pods and pod yield. Pre emergence application of Pendimethalin 1.0 kg a.i./ha followed by one hand weeding at 15 days after sowing resulted in 10.8 pods/ plant as against 4.97 pods/ plant in unweeded control. In these treatments nodules per plant were 60.0 vs 37.5 in unweeded plots, with pod yield 1658 kgha-1 vs 677 kgha-1 in unweeded control. Pre-emergence spray of Pendimethalin @ 1.0 kg a.i./ha followed by post emergence Imazethapyr @ 75 g a.i./ha at 15 days after sowing increased pod yield (1255 kgha-1) as compared to unweeded control.

Effect of weed management practices on economics of groundnut

Suganya Devi *et al.* (2011) reported that application of oxyfluorfen 250 g/ha followed by Imazethapyr 100 g/ha showed lower weed density, dry weight and higher weed control efficiency at 45 and 60 DAS in irrigated *rabi* groundnut. Yuvraj *et al.* (2012)^[74] reported that pre-emergence application of Pendimethalin @ 1.0 kg a.i./ha followed by post emergence Imazethapyr @ 75 g a.i./ha at 15 days after sowing increased pod yield (1255 kg ha-l), shelling% and 100 kernel weight in their experiment on integrated weedmanagement in groundnut (*Arachis hypogaea*). Babu *et al.* (2010) concluded that new formulation of Imazethapyr (10% SL) with different doses could be very effective against most of the broad leaved and grassy weeds in groundnut. Dry matter production and yield of sunflower and pearl millet did not show any variation among the weed control treatments and there was no residual toxicity due to Imazethapyr on the succeeding crops. Srinivasrao *et al.* (2010) reported that the higher benefit cost ratio (1.77) with Pendimethalin 1.0 kg / ha as PE *fb* Imazethapyr 100 g/ha at 20 DAS which was comparable with Pendimethalin 1.0 kg/ha as PE *fb* hand weeding at 40 DAS (1.72) and inter cultivation with star weeder at 20 DAS *fb* hand weeding at 40 DAS (1.71) treatments. Sudharsan *et al.* (2012) reported that at recommended dose the Imazethapyr affected nodule formation and nitrogen fixation but the effect was transient. Mean groundnut yield in inoculated plots was 6.9% higher (2150 kg/ha) than the un inoculated treatments. Highest groundnut yields recorded in Imazethapyr 75g/ha treatment indicated its efficient weed control.

Effect on rice- groundnut cropping system

Whitbread *et al.* (2003) remarked that sustainable farming/cropping systems require crop yields should be stable through the maintenance of soil fertility and the balance of nutrients in the system. Increases in soil carbon levels require sustained periods of balanced fertilization and residue retention. Talathil *et al.* (2000) in their study on the effect of integrated nutrient management on the fertility status, productivity and economics of rice (*Oryza sativa* L.) – groundnut (*Arachishypogaea* L.) cropping system reported that judicious use of organic manures like FYM and glyricidia with inorganic fertilizers improved the availability of NPK in the soil significantly. As a green manure crop, *Dhaincha* can substitute for applied fertilizer N (Raju and Reedy, 2000, Mann and Ashraf, 2000) in addition to supplying organic

matter for the restoration of soil physical conditions. The use of *Dhaincha* (*Sesbania aculeate*) as green manure improves soil productivity through biological nitrogen fixation (Zia *et al.*, 1965; Ladha, *et al.*, 2000). *Sesbania* green manure increases uptake of P, K, Zn, Fe, Mn, Cu by rice plants (Vaiyapuri and Sriramachandrasekharan, 2001).

Conclusion

Therefore the major challenges for farmers are integrated Nutrient management and effective weed control,. Manual removal of weed is labour intensive, tedious and does not ensure weed removal at critical stages of crop-weed competition. In recent times herbicides are becoming increasingly popular among farmers. The choice of chemical herbicides depends upon weed type and degree of weed infestation in rice field. Thus effective weed control often requires a combination of cultural, mechanical and chemical control such as an integrated weed management approach to delay herbicide resistance and reduce the herbicide load in the agro-ecosystem. Similarly Integrated nutrient management in rice improves the soil health by change of physico- chemical properties of soil. Hence judicious combination of integrated nutrient management and weed control in rice-groundnut cropping system is very essential for higher productivity, better resource use efficiency and profitability of the system.

References

1. AICRPWC. Experimental results, Annual Report, All India Co-ordinated Research Project on Weed Control, OUAT, BBSR, 2010, 28-33.
2. Bhagavatha Priya T, Subramanyam D, Sumati V. Weed Dynamics and Yield of Groundnut as influenced by Varieties and plant population, Indian Journal of Weed Science. 2015; 47(1):75-7.
3. Bhanu Rekha K, Kavitha P, Srinivasa R. Performance of herbicides for weed control in rice, Andhra Agricultural Journal. 2004; 5(1&2):1-4.
4. Bhanu Rekha K, Raju MS, Reddy MD. Effect of herbicides in transplanted rice, Indian Journal of Weed Science. 2002; 34(1&2):123-125.
5. Bhowmick MK, Ghosh RK. Sole and combined use of herbicides for weed control in transplanted rice during dry season, *Oryza*. 2008; 43(1):45-47.
6. Black GR, Bulk density. In: Black, C.A. (Ed.). Methods of Soil Analysis. Part I. Physical and Mineralogical Properties, SSSA Inc: 1965, 374-390.
7. Blanco-Canqui H, Lal R, Post WM, Izaurralde RC, Owens LB. Rapid changes in soil carbon and structural properties due to stover removal from no-till cornplots, Soil Science. 2006; 171:468-482.
8. Brar HS, Bhullar MS. Nutrient uptake by direct seeded rice and associated weeds as influenced by sowing date, variety and weed control, Indian Agricultural Research. 2013; 47(4):353-358.
9. Chander S, Pandey J. Nutrient removal by scented basmati rice (*Oryza sativa*) and associated weeds as affected by nitrogen and herbicides under different rice cultures, Indian Journal of Agronomy. 2007; 42(2):256-260.
10. Christos A, Damalas KV, Ilias G. Bispyribac-sodium efficacy on early water grass (*Echinochloaoryzoides*) and late water grass (*Echinochloaphyllopogon*) as affected by application of selected rice herbicides. Weed Technology. 2008; 22:622-627.

11. Ganai MA, Hussain A, Bhat A. Bio-efficacy of different herbicides in direct seeded rice (*Oryza sativa*) under temperate Kashmir valley conditions, Indian Journal of Agronomy. 2014; 59(1):86-90.
12. Gangwar KS, Gill M, Tomar OK, Pandey DK. Crop establishment methods on growth productivity and soil fertility of rice (*Oryza sativa*) based cropping system, Indian Journal of Agronomy. 2008; 53(2):102-106.
13. Ghildyal BP. Soils and rice, Int. Rice Res. Inst, Los Banos, Phillipines, 1978, 317-336.
14. Ghosh RK, Bhowmick Malay K, Das SC, Jena PK. Herbicidal management of weeds in groundnut (*Arachishypogaea*). Journal of oilseeds Res. 2001; 18(2):195-197.
15. Goel B, Verma S. Chemical weed control in rice – wheat rotation. In Proceedings of Indian Society of Agronomy, National Symposium held in Hisar, India, 14-16 March, 2007, 62-67.
16. Gupta RP, Kumar S, Singh T. Soil management to increase crop production, Indian Council of Agricultural Research, New Delhi, 1984.
17. Halder J, Patra AK. Effect of chemical weed control methods on productivity of transplanted rice, Indian Journal of Agronomy. 2007; 52(2):111-113.
18. Halder J, Sahoo KC, Karmakar SK, Nayak RN. Productivity and sustainability of different crop establishment methods for cultivation of rabi rice in Western Orissa, Annals of Agricultural Research. 2009; 30(3&4):82-86.
19. Heshmati M, Abdu A, Jusop S, Majid N. Effects of Land Use Practices on the Organic Carbon Content, Cation Exchange Capacity and Aggregate Stability of Soils in the Catchment Zones, American Journal of Applied Sciences. 2011; 8(12):1363-1373.
20. IRRI. World Rice statistics online query facility web page, 2014. <http://ricestat.irri.org:8080/wrs/2/entrypoint.html> (accessed 21.04.14)
21. Jacob D, Elizabeth K. Syria. Performance of Transplanted Scented Rice (*Oryza sativa* L.) under Different Spacing and Weed Management Regimes in Southern Kerala, Journal of Tropical Agriculture. 2005; 43:71-73.
22. Jat RS, Meena N, Singh AL, Jaya Surya N, Mishra JB. Weed management in ground nut Agricultural Reviews. 2011; 32:3.
23. Kemper WD, Rosenau RC. Aggregate stability and size distribution Methods of Soil Analysis 2nd edition, Part1, Physical and Mineralogical Methods, 1986, 425-442.
24. Khare TR, Sharma R, Sovan V. Control of complex weed flora in direct seeded and transplanted rice with early post emergence herbicide, *Oryza*. 2014; 51(1):96-99.
25. Kiran YD, Subramanyam D, &Sumathi V. Growth and yield of transplanted rice (*Oryza sativa*) as influenced by sequential application of herbicides. Indian J Weed Sci. 2010; 42(3 & 4):226-228.
26. Kumar GS. Effect of systems of cultivation with varied N levels on growth, yield, water productivity and economics of rice. Crop Research. 2008; 35(3):157-164.
27. Ladha JK, Kirk GJD, Bennett J, Peng S, Reddy CK, Reddy. Opportunities for increased nitrogen use efficiency from improved lowland rice germplasm. Field Crops Research. 2000; 56:41-71.
28. Ladha SS. Weed management for direct sown rice under rainfedupland situation. Indian Journal of Agronomy. 2011; 53:221-224.
29. Ladha SS, Gupta JK, Lav RK, Bhushan Rao AN. Weed management in aerobic rice systems under varying establishment methods, Crop Protection. 2008; 27(3-5):660-671.
30. Mahajan G, Chauhan BS. Role of integrated weed management strategies in sustaining conservation agriculture systems, Current Science. 2012; 103:135-136.
31. Mahajan G, Chauhan BS, Johnson DE. Weed management in aerobic rice in Northwestern Indo-Gangetic plains, Journal of Crop Improvement. 2009; 23(4):366-382.
32. Maity SK, Mukherjee PK. Integrated Weed management in dry direct-seeded rice (*Oryza sativa*), Indian Journal of Agronomy. 2008; 53(2):116-120.
33. Manjunatha B, Hanumanthappa M, Nahesha L, Kalyanamurthy KN, Kamath SKV. Effect of new herbicides on nutrient uptake in transplanted rice in Western Karnataka. Journal of Agricultural Science. 2012; 46(4):928-930.
34. Malsunaka S. Evolution of rice weeds control practices and research: World perspective, Proceedings 1981 - conference on weed control in Rice, International Rice Research Institute, Los Banos, Phillipineo, 1983, 5-18.
35. Mishra L, Singh VP. Effect of tillage and weed control on weed dynamics, crop productivity and energy use efficiency in rice based cropping system in Vertisols, Indian journal of Agricultural science. 2011; 81(2):129-133.
36. MoA GOI. Area, production and yield of principal crops, Agricultural statistics at a glance-2014. 2015; 1:71-72.
37. Mohanty TR, Maity SK, Roul PK. Response of rice to establishment methods and nutrient management methods and nutrient management practices in medium land, *Oryza*. 2014; 51(2):136-142.
38. Moorthy BTS, Saha S. Bio-efficacy of certain new herbicide formulations in puddle-seeded rice, Indian Journal of Weed Science. 2002; 34(1-2):46-49.
39. Pandey DP, Gangwar KS, Choudhary VP. Weed management in direct sown rice. *Oryza*. 2009; 46(2):165-166.
40. Payman G, Singh S. Effect of seed rate, spacing and herbicide use on weed management in direct seeded upland rice (*Oryza sativa* L.), Indian Journal of weed science. 2008; 40(1&2):11-15.
41. Piper CS. Soil and plant analysis. International Science Publication. Inc. New York, 1950.
42. Poonamperuma FN. The chemistry of submerged soils, Advances in Agronomy. 1972; 24:29-96.
43. Prasad SM, Mishra SS, Singh SJ. Effect of establishment methods, fertility levels and weeded management practices on rice (*Oryza sativa* L.), Indian Journal of Agronomy. 2001; 46(2):216-221.
44. Radford PJ. Growth analysis formulae, their use and abuse, Crop Science. 1967; 7(1):171-175.
45. Raju RA, Reedy MN. Integrated management of green leaf, compost, crop residues and inorganic fertilizers in rice (*Oryza sativa*) - rice system. In: Indian Journal of Agronomy. 2000; 45:629-635.
46. Raju M, Pandian BJ. Performance of wet seeded rice under different weed management practices, *Oryza*. 2001; 38(1&2):45-47.

47. Ram M, OM Kumar H, Dhiman SD. Chemical weed control in direct-seeded rice (*Oryza sativa*) with or without sequential application of 2,4-D(EE), Indian Journal of Agronomy. 2004; 49(2):108-110.
48. Ramesh T, Sathiya K, Padimanaban PK, James G. Optimization of nitrogen and suitable weed management practice for aerobic rice, Madras Agriculture. 2009; 96(9-12):344-348.
49. Rana SS, Angiras NN, Sharma SW. Effect of herbicides and interculture on nutrient uptake by puddle seeded rice and associated weeds, Indian Journal of weed Science. 2002; 33(1&2):70-73.
50. Rao AN, Johnson DE, Sivaprasad B, Ladha JK, Mortimar AM. Weed management in direct seeded rice, Advances in Agronomy. 2007; 93:153-255.
51. Saha S, Chakraborty D, Sharma AR, Tomar RK, Bhadraray S, Sen U *et al.* Effect of tillage and residue management on soil physical properties and crop productivity in maize (*Zea mays*)–Indian mustard (*Brassica Juncea*) system, Indian journal of Agricultural Sciences. 2010; 80(8):679-685.
52. Saha S. Comparative study on efficiency of sulfonylurea herbicides and traditional recommended herbicides in transplanted rice (*Oryza sativa*), Indian Journal of Agronomy. 2006; 51(4):304-306.
53. Saha S. Efficacy of Benusulfuron-methyl for controlling sedges and non grassy weeds in transplanted rice (*Oryza sativa* L.), Indian Journal of Agricultural Science. 2009; 34(1-2):36-38.
54. Saha S. Evaluation of some new herbicide formulations alone or in combination with hand weeding in direct-sown rainfed lowland rice (*Oryza sativa* L.), Indian Journal of weed Science. 2005; 37(1-2):103-104.
55. Sahrawati KL. Fertility and organic matter in submerged rice soils, Current Sciences. 2005; 88(5):735-739.
56. Sairamesh KV, Rao AS, Subhaiah G, Prasuna Ran P. Effect of sequential application of herbicides on nutrient uptake by wet seeded rice and its association weeds, The Andhra Agricultural Journal. 2011; 58(4):559-561.
57. Sharma AR, Singh R. Weed management in conservation agriculture systems problems and prospects.(In:) Abstracts, Biennials conference of ISWS on Weed Threat to Agriculture, Biodiversity and Environment, held during 19-20 April 2012, Indian society of weed science Research, Jabalpur, India, 2012, 3.
58. Singh AP, Singh AK, Mishra OP. Bioefficacy of sulfonyl urea herbicides on mixed weed flora in transplanted rice, Indian Journal of Agricultural Research. 2012; 46(1):9-25.
59. Singh G. Effect of weed management practices on direct seeded rice under puddle lowlands, Indian Journal of Agronomy. 2005; 50(1):35-37.
60. Singh M, Singh RP. Influence of crop establishment methods and weed management practices on yield and economic of direct-seeded rice (*Oryza sativa*), Indian journal of Agronomy. 2010; 55(3):224-229.
61. Singh R, Singh G, Sen D, Tripathy SS, Singh RG, Singh M. Effect of herbicides on weeds in transplanted rice, Indian Journal of Weed Science. 2005; 36(3-4):184-186.
62. Singh RP. Effect of crop establishment methods, weed management and split nitrogen application on weeds and yield of rice (*Oryza sativa*), Indian Journal of Agricultural Science. 2005; 75(5):285-287.
63. Singh RP, Singh CM, Singh AK. Effect of crop establishment methods, weed management and splitting of N on rice and associated weeds. Indian Journal of Weed Science. 2003; 35(1&2):33-37.
64. Singh RP, Singh CM, Singh AK. Effect of crop establishment methods and weed management on growth analysis parameters of rice (*Oryza sativa* L.), *Oryza*. 2004; 41(3&4):120-124.
65. Singh S, Ladha JK, Gupta RK, Lav Bhusan Rao AN, Sivaprasad B, Singh PP. Evaluation of mulching, intercropping with Sesbania and herbicide use for weed management in dry-seeded rice (*Oryza sativa* L.), Crop Protection. 2007; 26:518-524.
66. Six J, Bossuyt S, Denef K. Review A history of research on the link between (micro) aggregates, soil biota and soil organic matter dynamics, Soil and Tillage Research. 2002; 79:7-31.
67. Subbiah BV, Asija GL. A rapid procedure for estimation of available nitrogen in soils, Current Science. 1956; 25:259-63.
68. Vilas Bhalel M, Jayashri Karmore V, Yuvraj Patil R, Dr. Panjabrao Deshmukh, Integrated Weed Management In Groundnut (*Arachis hypogea*) Pak. J Weed Sci. Res. 2012; 18:733-739. Special Issue
69. Vaiyapuri V, Sriramachandrasekharan MV. Effect of organic manures on the nutrient uptake, yield and nutrient use efficiency in lowland rice. In Journal of Ecobiology. 2001; 13:143-147.
70. Veeraputhiran R, Balasubramanian R. Evaluation of bispyribac sodium in transplanted rice, Indian Journal of Weed Science. 2013; 45(1):12-15.
71. Watson DJ. The dependence of net assimilation rate on leaf area index, Ann. Bot. (N.S.). 1958; 22:37-54.
72. Wrigley G. The problem of Weeds in rice, Rice Technology, Monogr.No.1. CIBA, Basal, 1969, 27-31.
73. Yadav DB, Yadav A, Punia SS. Evaluation of bispyribac-sodium for weed control in transplanted rice, Indian Journal of Weed Science. 2009; 41(1-2):23-27.
74. Yuvraj Patil R, Vilas M, Bhale Jayashri, Karmore V. Integrated weed management in groundnut, Bhartiya Krishi Anusandhan Patrika. 2012; 27:2.
75. Zia MS, Aslam NC, Gill MA. Nitrogen management and use efficiency for lowland rice in Pakistan. Soil Sci. Plant. (Japan). 1965; 38:111-121.