A field experiment entitled, “Studies on integrated nutrient management through vermicomposting in direct seeded rice-wheat sequence” was conducted at the experimental farm of Department of Agronomy, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur during Kharif 2003, Rabi 2003-04, Kharif 2004 and Rabi 2004-2005. The experiment aimed to find out suitable level of vermicompost in direct seeded rice-wheat sequence. Other objectives of study were to find out the effect of vermicompost with different levels of NPK fertilizers in direct seeded rice-wheat crop sequence and to study the economics of various treatments under investigation.

The field experiment consisted of 13 treatments combinations of 4 vermicompost levels viz., no vermicompost, vermicompost @ 2 t/ha, vermicompost @ 4 t/ha and vermicompost @ 6 t/ha and three levels of chemical fertilizers viz., 1/3rd of recommended NPK, 2/3rd of recommended NPK and recommended NPK and one absolute control. These treatments were applied to paddy crop and its residual effect was studied in wheat crop by raising wheat with the application of 50% of recommended N through chemical fertilizers.

The salient findings obtained from the field as well as laboratory studies have been summarized in this chapter.
1. Plant height was significantly influenced by levels of vermicompost and different levels of chemical fertilizers. Vermicompost @ 6 t/ha and recommended dose of NPK fertilizers resulted in significantly higher plant height of paddy crop than all other treatments and at all stages of crop growth except at harvest stage (*Kharif* 2004) during both the years of study. Significantly higher plant height was recorded with vermicompost @ 6 t/ha + recommended NPK fertilizer dose.

2. Use of vermicompost @ 6 t/ha and application of recommended dose of NPK fertilizers, resulted in significantly higher dry matter accumulation of paddy crop than all other treatments and at all the stages of crop growth and during both the years of study, except at 90 days after sowing (*Kharif* 2003) where it was at par with application of vermicompost @ 4 t/ha.

3. Use of vermicompost @ 6 t/ha as well as application of recommended dose of fertilizers, resulted in significantly higher number of shoots/m² than all other treatments, except at 60 and 90 days after sowing (*Kharif* 2003) and 60 days after sowing (*Kharif* 2004), where it was found to be at par with vermicompost @ 4 t/ha.

4. Days taken to reach panicle initiation stage, flowering stage and maturity decreased significantly with increase in the level of vermicompost from no vermicompost to vermicompost @ 6 t/ha, however, these characters, in general, were not affected by different levels of fertilizers.
5. Vermicompost @ 6 t/ha resulted in significantly higher number of panicle/m², number of spikelets/panicle, weight/panicle and 1000-grain weight than other three levels of vermicompost, whereas, lowest spikelet fertility per cent was recorded with the application of vermicompost @ 6 t/ha than other levels of vermicompost. Number of panicles/m² were not significantly influenced by fertilizers levels, whereas, application of recommended dose of NPK fertilizers resulted in higher number of spikelets/panicle, panicle weight and 1000-grain weight than other two levels of fertilizers viz. 1/3rd of recommended NPK and 2/3rd of recommended NPK fertilizers.

6. Vermicompost @ 6 t/ha as well as application of recommended dose of NPK fertilizer resulted in significantly higher grain yield of paddy than other three levels of vermicompost during both the years of study, however, it was found to be at par with application of vermicompost @ 4 t/ha.

7. Vermicompost @ 6 t/ha as well as application of recommended dose of fertilizers resulted in significantly higher straw yield of paddy than all other treatments during both the years of study. Vermicompost @ 6 t/ha + recommended NPK fertilizers remaining at par with vermicompost @ 6 t/ha + 2/3rd of recommended NPK fertilizers resulted in higher straw yield than all other treatment combinations.
8. With the increase in levels of vermicompost from no vermicompost application to vermicompost @ 6 t/ha resulted in lower harvest index values with no vermicompost resulted in higher harvest index. Fertilizer levels did not significantly influence the harvest index.

9. Vermicompost @ 6 t/ha and application of recommended doses of NPK fertilizers resulted in significantly higher N, P and K uptake by paddy as compared to other treatments during both the years of study. However, application of vermicompost @ 4 t/ha and 6 t/ha were found to be at par with each other with respect to N, P and K uptake by paddy crop.

10. Application of vermicompost @ 6 t/ha resulted in significantly higher gross returns in paddy than other three levels of vermicompost during both the years of study. Application of recommended dose of NPK fertilizer resulted in higher gross returns as well as net returns than all other levels. With the increase in vermicompost levels from 0 t/ha to 6 t/ha, there was a decrease in net returns and net returns per rupee invested, whereas, with increase in fertilizer levels from 1/3\textsuperscript{rd} of recommended NPK to recommended NPK, net returns and net returns per rupee invested increased significantly.
11. With the increase in the levels of vermicompost application to paddy from 0 t to 6 t/ha, resulted in increase in wheat grain and straw yield and application of vermicompost @ 6 t/ha to paddy, resulted in highest grain and straw yield of wheat during both the years of study i.e. vermicompost @ 6 t/ha to paddy showed higher residual effect on wheat yield. During both the years of study, harvest index of wheat was found to be non-significant. Absolute control proved to be inferior to all other treatments.

12. With the increase in the level of vermicompost application to paddy from 0 t/ha to 6 t/ha, resulted in significant increase in N, P and K uptake by wheat crop, during both the years of study, with application of vermicompost @ 6 t/ha resulted in significantly higher N, P and K uptake than all other treatments. Similarly application of recommended NPK fertilizers to paddy crop also resulted in significantly higher NPK uptake in wheat during both the years of study.

13. Application of vermicompost @ 6 t/ha to paddy crop in previous season to paddy crop, resulted in significantly higher gross returns, net returns and net returns per rupee invested in wheat over other three levels of vermicompost viz. 0t/ha, 2 t/ha and 4 t/ha. Similarly application of recommended dose of NPK fertilizer to previous paddy crop, resulted in significantly higher gross returns, net returns and net returns per rupee invested in wheat during both the years of study.
14. On the basis of average values of gross and net returns for direct seeded rice-wheat sequence, it was observed that application of vermicompost @ 6 t/ha to paddy crop resulted in highest gross and net returns than all the levels of vermicompost. Similarly application of recommended dose of NPK fertilizers also resulted in highest gross and net returns in direct seeded rice-wheat sequence.

15. Application of vermicompost at various levels as well as application of different fertilizer levels did not significantly influence the pH and soil texture of soil at the end of the experiment. However, there was significant increase in pH over control treatment.

16. Use of vermicompost @ 6 t/ha as well as application of recommended dose of fertilizers, resulted in an increase in organic carbon content of soil at the end of experiment, and resulted in built up of organic carbon content in soil over initial values.

17. Use of higher levels of vermicompost resulted in lowering of bulk density of the soil at the end of experiment. However, particle density was not influenced by any of the treatments.

18. Application of vermicompost @ 6 t/ha and application of recommended dose of NPK fertilizer resulted in substantial available N, P, K build up at the end of experiment.
CONCLUSION

The results of present study convincingly conclude that:

1. Application of vermicompost @ 6 t/ha proved to be sufficient in direct seeded rice-wheat sequence.

2. With respect to grain and straw yield application of vermicompost @ 6 t/ha was found to be most suitable in rice-wheat sequence, whereas, for nutrient uptake vermicompost @ 6 t/ha remaining at par with vermicompost @ 4 t/ha was found to be most suitable levels. Application of 6 t/ha of vermicompost alongwith 2/3rd of recommended NPK was found to be most suitable for yield and nutrient uptake and a saving of 33 per cent of NPK fertilizers can be obtained.

3. On an average basis application of vermicompost @ 6 t/ha to paddy crop in direct seeded rice-wheat sequence resulted in higher gross and net returns than all the other three levels of vermicompost viz. vermicompost @ 2 t/ha, 4 t/ha and no vermicompost application. Application of recommended dose of NPK fertilizer also resulted in higher gross and net returns than other two levels of fertilizers viz., 1/3rd and 2/3rd recommended NPK in direct-seeded rice-wheat sequence.