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Conceptual Paper

Water in Economy - Aquaculture

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What is Aquaculture?

Aquaculture is a water based Farming system or business. It refers to the breeding, rearing, and harvesting of plants, animals, fish and shellfish farming, in aquatic environments including ponds, rivers, lakes, and the ocean. Or in other words, aquaculture is the fresh or salt water farming of any fish, shellfish or aquatic plants.

Aquaculture is called the "Blue Revolution". It is relatively new industry in western world as it's only been in the last 30 - 40 years that is has become a major industry. Since 1970s, global aquaculture production has been growing rapidly at a rate of about 9% per year. Today, aquaculture produce at least 50% of the world seafood and will likely continue to grow its production into the for seeable future as the demand for fish protein increase and the ability of wild fish stocks to meet the demand continues to dwindle due to overfishing and insufficient regulation.

Figure

Initiation of Aquaculture

In 2500 BC, aquaculture initiated in china. They trap crap and some fish in lakes when water subsided after river floods. Seaweed was first cultivated by Japanese using bamboo poles and, later, nets and oyster shells. Romans used Coastal areas for breeding fish in ponds. Aquaculture spread in Europe during the Middle age's since away from the seacoasts and the big river, fish had to be settled so that they don't rot. Oyster farming had begun in estuarine along the Atlantic coast of North America during 18th century. By the 1920s, The American Fish culture company of Carolina, Rhode Island, founded in the 1870s was the leading producer of trout. Method of manipulating the day and night cycle of fish initiated in 1940s, as a result they could be artificially spawned year around. In 20th century Aquaculture spread vastly and so called "Blue revolution" occurs as like Green revolution.

How Aquaculture is done?

a) **Extensive way**: Stocking mainly with no fertilization and feeding.it is mainly done with the three Indian major and three exotic (silver, common and grass) carps.

b) **Extended way**: Disrupted or irregular fertilization without feeding. i.e. Silver barb stocked occasionally.

c) **Semi intensive way**: Regular fertilization (both organic and inorganic) and feeding (containing of rice bran and oil cakes). Silver barb, freshwater prawn and Nile tilapia and striped catfish is stocked.

d) **Intensive way:** Catfish Monoculture. Regular feeding. Commercially manufactured pelleted diet.

Main Groups of Species: Approximately 580 species are farmed globally. It includes:

1. 362 finfishes (including hybrids)
2. 104 mollusks
3. 62 crustaceans
4. 7 frogs and reptiles
5. 10 aquatic invertebrates
6. 37 aquatic plants

Aquaculture in Bangladesh

In Bangladesh 2.2 million people are involves directly with fishing and another 11 million people are involved indirectly with this. Bangladesh has 580 kilometer (362 miles) cost line. Total offshore area is 125000 sq.km where occupying 70.000 sq.km for fishing. And 10,000 sq.km inland areas recovered with water like River and water bodies. Bangladesh ranked 5th as aquaculture producing country in the world (FAO, 2015). Last 10 years average growth rate of fisheries is 5.4%. Where aquaculture shows the growth performance of 8.2%.

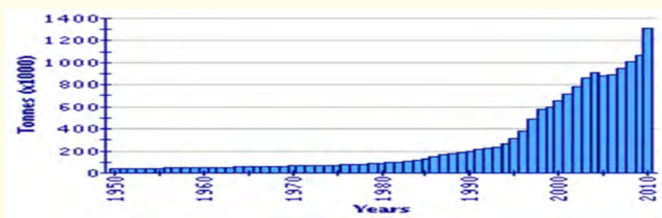

Figure 1: Aquaculture production in Bangladesh (From 1950- 2010).

Global Aquaculture production

Aquaculture production of 0.2 metric ton in 2014 was recorded by 25 countries. 96.3% of farmed fish and 99.3% of farmed aquatic plants collectively produced by them. In 2012, the total world production of fisheries was 158 million tons, of which 66.6 million tons is from aquaculture. Chinese Bureau of Fisheries reports, aquaculture harvests grew at an annual rate of 16.7% jumping from 1.9 million tones to nearly 23 million tons between 1980 and 1997.70% of world production of aquaculture is done by China.

Is Aquaculture a Thread or a Blessing?

As like every coin has two side Aquaculture have both its benediction and Curse.

Negative impacts

1. **Environmental:** Most of the ecological consequences of aquaculture development affect coastal zone. Habitat loss/modification, excessive harvesting of wild seed/spawners and damage to by catch, introductions of exotic species, escapes of cultured animals, spread of diseases, interactions with wild populations, misuse of chemicals and antibiotics, release of wastes, and dependence on wild fisheries are some impacts on environment of coastal zone.

Region	Country (position wise)	Percentage (%)
Asia	China	61.6%
	India	6.6%
	Indonesia	5.8%
	Vietnam	4.6%
	Bangladesh	2.65%
		Total - 88.9%
America	Chile	1.6%
	other	2.94%
		Total - 4.54%
Europe	Norway	1.8%
	others	2.17%
		Total - 3.97%
Africa	Egypt	1.5%
	others	0.82%
		Total - 2.32%
Oceania		0.26%
	Total	100%

Table 1: Aquaculture production 2014: Regional production and top 10 producer.

2. **Socio-economic:** Loss of mangrove goods and services, blocked access to coastal resources by pond and pen/cage structures; and navigational hazards; privatization of public lands and waterways; conversion of residential, agricultural (rice, pastures) and common lands; salinization of domestic and agricultural water supplies; fisheries decline and food insecurity; rural unemployment and urban migration; and in some cases human rights abuses, social disruption, conflicts and violence.

Positive Impacts

1. Create jobs in rural areas.
2. Can increase revenue at national level.
3. Reduce seafood trade deficiency.
4. Can help to feed a growing world population.
5. Can encourage local investment.
6. Increase use of scientific knowledge and technology.
7. Protect coastal water from pollution, for example in the case of mollusk and seaweed culture.
8. Reduce fishing pressure.

Aquaculture in a Sustainable Way

Aquaculture fulfill food security and poverty alleviation without causing negative environmental and socioeconomic effects, So, more holistic approach is required to make it sustainable. Issues that needs to consider are suggested below:

1. Integrated coastal zone management (ICZM) process must be used in coastal zones for fisheries, aquaculture and tourism.
2. Development of available on-farm technologies (e.g. recycling), and integration of aquatic species (polyculture of tilapia/fish and shrimp in ponds) to mitigate negative impacts and increasing sustainability.
3. Adaptation of farm sitting procedure so that the (waste) absorbing or assimilative capacity of the environment is not exceeded.
4. Water quality standards must be applied equally to pond water as to drainage waters flushed into adjoining habitats.
5. For all kind of farm like -small-scale, large-scale or family-based operations mangrove-friendly aquaculture technologies must be adopted for conservation of mangrove.

Water is the backbone of Aquaculture and In recent years Aquaculture is becoming a great part or controller of world Economy. We should proceed it by saving its Backbone so that it can become the backbone of world economy in future.

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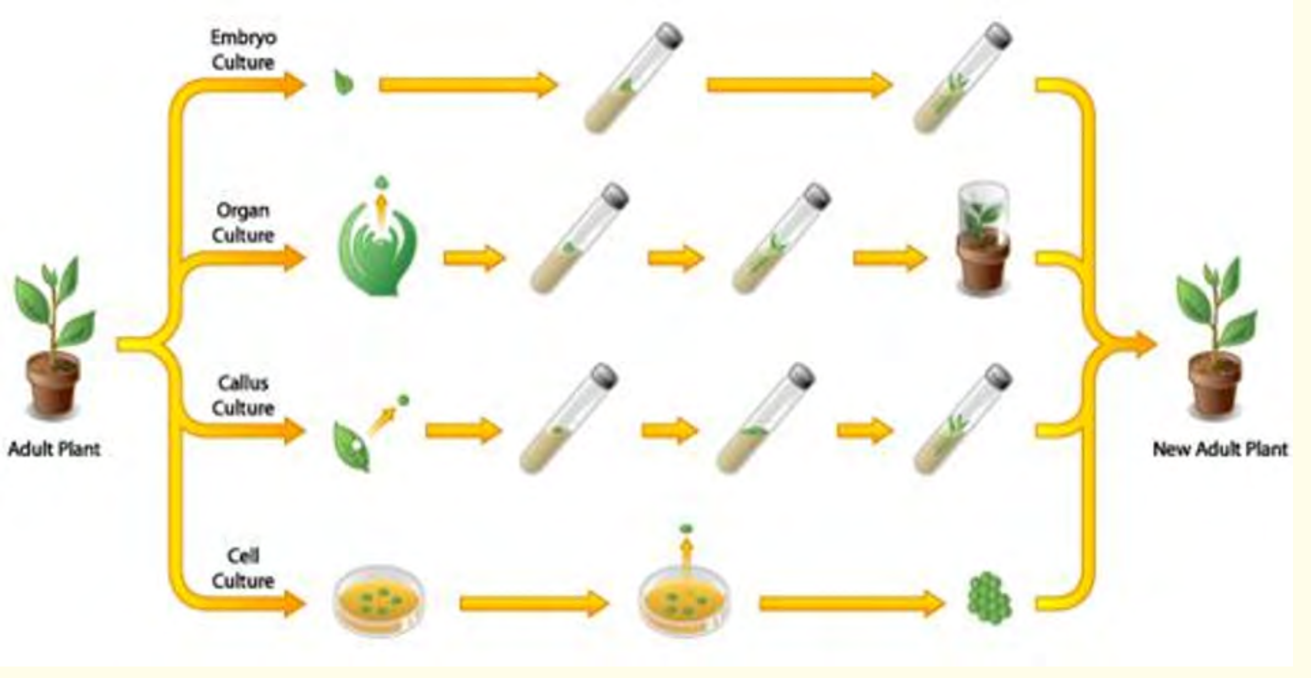

Figure 4: Steps in Plant tissue culture. Image Courtesy: TNAU Agritech.

Plant Tissue Culture Procedure

Basic Steps in plant tissue culture starts form choice of explant. Explant in biology is cell, organ or piece of tissue which can be used to transfer and regrow into whole specimen on adequate supply nutrient medium in vitro. Plant have the property of totipotency which is capability of cell to divide and differentiate to form a working specimen [9]. Thus, in case of plants, explant can be taken from various parts and portion of plant's shoot, steams, leaves, flowers, roots or any undifferentiated plant cell mass. This is then exposed to various types of nutrient media to explore the property of totipotency [10]. Not all parts of plant grow readily. This varies from species to species and also within plant part, which implies choice of explant is an import factor. Other depending factor include optimised nutrient medium, different regeneration time and exposure of light. Most important part of growth of plant in tissue culture laboratory is that aseptic conditions have to be followed as there is a higher chance of contamination due to competition to consume nutrient media by other microbes [11].

After successful growth of plant in tissue culture medium in laboratory, the plant is grown further by exposing it to natural light and environment [12]. This process is termed as hardening. When a tissue culture plant accepts the natural environment then it is transferred into a pot with soil or land directly. The overall process consumes several weeks of time depending on factors like choice of plant species, choice of explant, and skilled labour to handle the tissue culture protocol.

Conceptual Use of ANN for Optimum Nutrient Media Composition

A way to reduce the time and resources required in plant tissue culture consumption, is by using an ANN and by making an effort to carry out the plant growth in various nutrient concentration experiment only once globally. Then making this result obtained by tissue culture experiment available as peer reviewed input data to be used all over the world. Now this data can be used in any standard computer using ANN compilers. Any required targeted changes can be modelled into the ANN and Change in input and output can be observed by running the experiment on simulation mode. The behaviour of plant growth in absence, excess or optimal concentration of any nutrient media can be studied [13]. This simulation can be done in minutes and would save the time and resources of vast number of scientist all over the globe performing individual experiment by tradition trial and error methods [14]. When satisfied by the simulation, the actual plant can be grown in the laboratory by using the results obtained from the simulation having already known the optimum and exact nutrient media required for the growth of the plants [15,16].

Current Experiments Done Globally

ANN is used in various chemical engineering and biotechnology computation process and been implemented as a successful computational model instead of carrying out each process individually [17]. In the year 2005, Research result has been accepted on the topic use of ANN for Corn and Soybean Yield Prediction performed by University of Maryland, USA [18]. Year 2009 marked the Prediction of average regional yield and production of Wheat in Argentine Pampas using ANN in Argentina [19]. In Year 2011 Authors of this paper i.e., we performed to study and replicate the experiment in Bioinformatics laboratory, Nagpur University, India as our Final Year Research Thesis on Optimization of Medium Composition for Thermo-stable Protease Production using ANN. This was originally performed and published in year 2008 at African Journal of Biotechnology [20]. Our observation and result closely matched that of the original experiment proving that Computational technique using ANN simulation can be replicated in any part of the world using different software or compliers once base research data is generated.

Materials and Methods

Materials Needed

A system with Basic ANN compilers is needed to design and run the computing. Some of the top names include Neural Designer, Neuroph, Darknet, Deep Learning Kit, DTERG, Synaptic and Torch.

Get Data: Graph Designer. This software can be used if user wishes to do the reverse of plotting a graph. Get data can create data points from the actual graph and present you with numerical values corresponding to the points in graph.

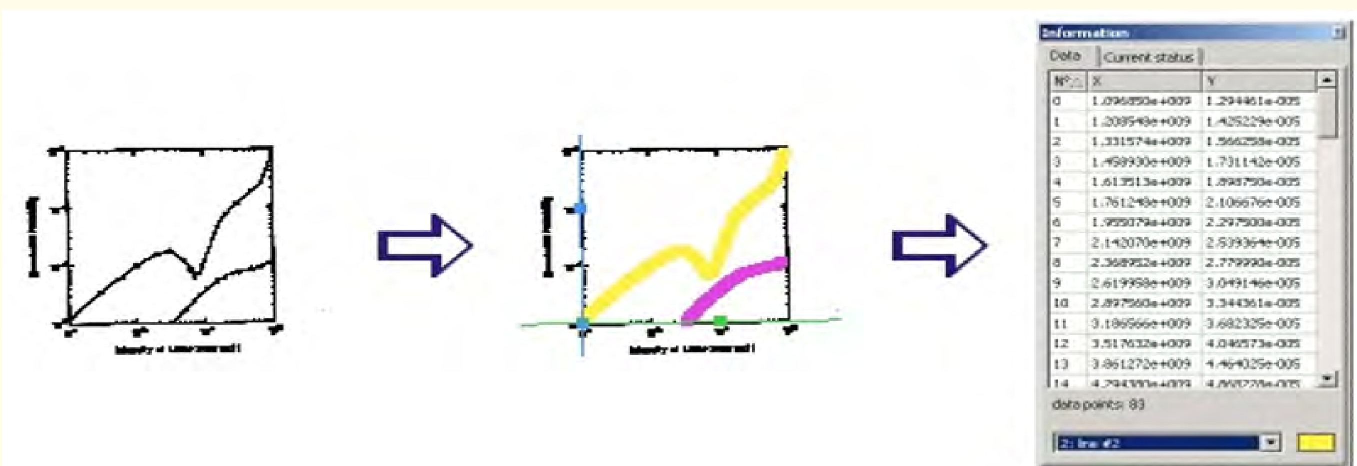

Figure 5: Get Data Graph Designer working Diagram. Image Courtesy Get Data Website.

Research Data: Actual Research Data is needed as input variable and corresponding output result. The data is required to be feed to teach the ANN so that computer compilers can learn the initial phase of the experiment data dependency. This data can be obtained by performing the actual experiment physically for the first time and/or requesting the authors of various papers published already to use their data for your research at the initial stage [21]. Traditional Plant Tissues culture paper published till date provides only the optimum growth condition data, where the result for the experiment was at its peak. And thus, accepting the new era of ANN requires more and more experiments to be done globally on plant biotechnology, generating and publishing data to be freely available to use by researchers over the globe. A step has already been initiated in this direction in departments like chemical engineering and process biotechnology and only few papers published in Plant tissue culture.

Experimental Methodology

A basic experiment to find the optimum nutrient media composition for the highest yield in plant growth can be done by taking various components of nutrient media as input source for ANN and the result with highest yield as output. Designing of the ANN to be feedback or feedforward mechanism can be determined if the output effects the input at any layer of the ANN. After giving the values of both input and targeted output to the ANN compliers, the ANN is run in the system. The first run of the system gives us an actual vs predicted result of the ANN in use. Higher the number of input variables used, higher is the accuracy. Also care should be taken while entering the data as ANN being Black Box model only works on pattern recognition of Input and Output data. Error in feeding any input value may result in accuracy of prediction of the ANN.

Run order	Experimental values				Protease activity (U/ml)
	Corn Starch	Soyabean meal	Glucose	Yeast extract	
1	12.0	6.0	3.0	3.0	5233
2	12.0	6.0	3.0	5.0	4921
3	12.0	6.0	5.0	3.0	4096
4	12.0	6.0	5.0	5.0	4350
5	12.0	14.0	3.0	3.0	5470
6	12.0	14.0	3.0	5.0	5236
7	12.0	14.0	5.0	3.0	5680
8	12.0	14.0	5.0	5.0	5514
9	28.0	6.0	3.0	3.0	5896
10	28.0	6.0	3.0	5.0	5364
11	28.0	6.0	5.0	3.0	5299
12	28.0	6.0	5.0	5.0	4703
13	28.0	14.0	3.0	3.0	4959
14	28.0	14.0	3.0	5.0	5231
15	28.0	14.0	5.0	3.0	4669
16	28.0	14.0	5.0	5.0	3008
17	20.0	10.0	4.0	4.0	6803
18	3.5	10.0	4.0	4.0	5142
19	36.5	10.0	4.0	4.0	4407
20	20.0	1.8	4.0	4.0	5397
21	20.0	18.2	4.0	4.0	4787
22	20.0	10.0	1.9	4.0	5687
23	20.0	10.0	6.1	4.0	4536
24	20.0	10.0	4.0	1.9	4937
25	20.0	10.0	4.0	6.1	5445
26	20.0	10.0	4.0	4.0	6630

Table 1: Experimental Data Run Order we used to test working for ANN in year 2011, Original contributed by Guangrong., *et al* [20].

To test the working of ANN, we use the research data from experiments of Guangrong., *et al.* on getting the optimum medium compostion for production of Thermo Stable Portease Production. Protease Produciton being the corresponding output targeted result like final yield in plant growth models. This was done by using the Graphical Values converted into numberial data using Get Data application. The final protease activiy calculated in units of U/ml was the data for the output layer of ANN. The output layer depends on the nutrient media compostion of four different sources of Carbon and Nitrogen. Thus we had four different input variable namely Corn Starch, Soyabean Meal, Glucose and Yeast Extract in units g/l. Each of the input variable reacted with each other in different concentrations givng us a different output layer. Input and Output Research Data from Run order 1 till Run order 22 in the table 1 is the the actual exprimental data, and from Run order 23 to 26 is the manual values we entered in the system to pridict the working of the ANN. It can be observed that in real experiment Run 17 gives the maximum protease production by its higherst corresponding activty in Output layer. The same when tested with Run 26 gave us the closely matching result as expected for the highest activity, giving the input in Run 17 is the optimum medium compostion for the sample data is learned by the ANN. More input data would provide better and accurate result.

Result and Discussion

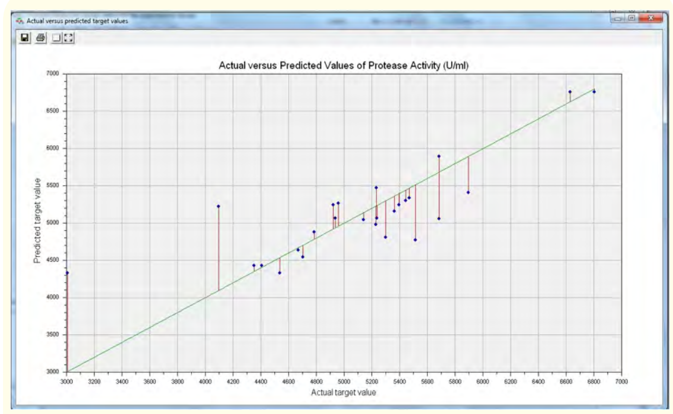

Figure 6: Actual vs Predicted target value of ANN.

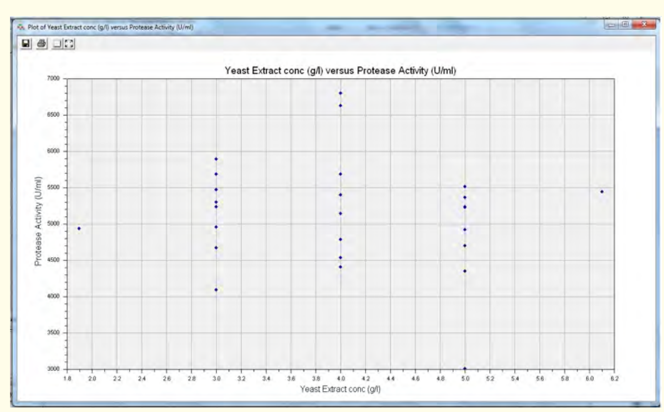

Figure 7: Screenshot of an Example Graph Produced by DTERG Software Comparing one variable (Yeast Exact conc) vs. final product output (protease activity).

The output of ANN produces various multi-dimensional graphs which are difficult in representation on 2-dimensional plane having x and y axis. Figure 7 shows such an example where Yeast Extract (one of input variable) concentration is plotted in x axis and Protease activity (corresponding result) on y-axis. This is because every one type of concentration of input effect the other type of concentration of input which in turn effects the results. Thus, for our observation and understanding Graphs can only be made on two-dimensional plane to compare and observe how either one input variables corresponds and effects to other input variable type. Or how one input type affects the overall output. When Graph are plotted having the increasing one variable concentration on x axis and increasing other variable or result values on y-axis, it produces all the dots of interaction which are observed while computing. The result sometimes is seen as random dots in the 2-Dimensional plane which does not form any linear line. An observer must understand at this stage that the nonlinear or random dots in a graph are produced due to other input variable (corn starch, glucose and soya bean meal in above example) are simultaneously acting on the reference variable of observation and causing the placement of dots at a certain point in the graph. In the 2-Dimensional graph the only point of observation can be made is the value where highest yield or interaction is observed and its average gives the concentration where output yield is maximum. These values from Graphs can be converted into numbers of its highest accuracy by using Get Data software or by simple observation techniques comparing x-axis to y-axis.

Another example results of various concentration for the Yield production of corn and soybean using ANN can be studied in research paper published on 11 September 2004 by University of Maryland USA [18]. Use of ANN in Plant tissue culture is still a developing concept and thus very few papers can be found which have the data as required by the use for ANN compliers. Thus, for other plant species more physical experiments can be carried out and data can be published which will benefit the ease of using ANN by scientist of the future in Plant Biotechnology and Agricultural Industry.

Conclusion

Artificial Neural Network is usually used to model complex relationships between various input and output and also to find patterns in data. A neural network can perform task that linear computational programme cannot. Thus, an ANN refers to a multilayer perception network which consist of input layer, hidden layer and an output layer.

To find the optimum concentration of nutrient medium require for high yield plant growth, various concentration of nutrient media is used as input into the input layer of the ANN and also corresponding result yield is fed as output to the concentration of respective input. The ANN when run on these data performs the co-relation of input vs. output and learns the dependency of each other. At the end of learning phase, the concentrations of highest yield can be selected and used in actual experiment as they are the optimum concentration of nutrient media for highest possible yield. In the same experiment, increase in concentration of any nutrient medium can also be studied to cause what changes it brings to the final yield by simulation growth. The ANN also determines the accuracy at which it works and thus relicense to the result can be interpreted.

Using ANN in Plant Biotechnology and Agriculture industry will save various resources for the experimental part of research and collective data sharing will make growth of industry at a rapid rate to suit the constant rise in demand of the increasing population.

Bibliography

1. Kanungo DP., *et al*. "A Comparative Study of Conventional, Ann Black Box, Fuzzy and Combined Neural and Fuzzy Weighting Procedures for Landslide Susceptibility Zonation in Darjeeling Himalayas". *Engineering Geology* 85.3-4 (2006): 347-366.
2. Schalkoff Robert J. "Artificial Neural Networks". Volume 1: McGraw-Hill New York (1997).
3. Suzuki Shin. "Artificial Neural Networks". *Mathematics of Neural Networks: Models, Algorithms and Applications* 8 (1997): 349.
4. Basheer Imad A and M Hajmeer. "Artificial Neural Networks: Fundamentals, Computing, Design, and Application". *Journal of Microbiological Methods* 43.1 (2000): 3-31.
5. Yao Xin. "Evolving Artificial Neural Networks". *Proceedings of the IEEE* 87.9 (1999): 1423-1447.
6. Haykin Simon S., *et al*. "Neural Networks and Learning Machines". Volume 3: Pearson Upper Saddle River, NJ, USA (2009).
7. Yegnanarayana B. "Artificial Neural Networks". PHI Learning Pvt. Ltd., (2009).
8. Dodds JH and LW Roberts. "Plant Tissue Culture". Cambridge University Press. New York (1987).

9. George Edwin F and Paul D Sherrington. "Plant Propagation by Tissue Culture". Exegetics Ltd., (1984).

10. Verdeil Jean-Luc., *et al*. "Pluripotent Versus Totipotent Plant Stem Cells: Dependence Versus Autonomy?" *Trends in Plant Science* 12.6 (2007): 245-252.

11. Loyola-Vargas., *et al*. "Plant Tissue Culture". Molecular Biomethods Handbook. Springer (2008): 875-904.

12. Gamborg Oluf L. "Plant Tissue Culture. Biotechnology. Milestones". *In Vitro Cellular and Developmental Biology-Plant* 38.2 (2002): 84-92.

13. Gallego Pedro P., *et al*. "Artificial Neural Networks Technology to Model and Predict Plant Biology Process". Artificial Neural Networks-Methodological Advances and Biomedical Applications. InTech (2011).

14. Gago J., *et al*. "Artificial Neural Networks as an Alternative to the Traditional Statistical Methodology in Plant Research". *Journal of Plant Physiology* 167.1 (2010): 23-27.

15. Prakash Om., *et al*. "A Neural Network Approach for the Prediction of in Vitro Culture Parameters for Maximum Biomass Yields in Hairy Root Cultures". *Journal of Theoretical Biology* 265.4 (2010): 579-585.

16. Prasad VSS and S Dutta Gupta. "Applications and Potentials of Artificial Neural Networks in Plant Tissue Culture". Plan Tissue Culture Engineering. Springer (2008): 47-67.

17. Montague Gary and Julian Morris. "Neural-Network Contributions in Biotechnology". *Trends in Biotechnology* 12.8 (1994): 312-324.

18. Kaul Monisha., *et al*. "Artificial Neural Networks for Corn and Soybean Yield Prediction". *Agricultural Systems* 85.1 (2005): 1-18.

19. Alvarez R. "Predicting Average Regional Yield and Production of Wheat in the Argentine Pampas by an Artificial Neural Network Approach". *European Journal of Agronomy* 30.2 (2009): 70-77.

20. Guangrong Huang., *et al*. "Optimization of Medium Composition for Thermostable Protease Production by Bacillus Sp. Hs08 with a Statistical Method". *African Journal of Biotechnology* 7.8 (2008).

21. Hoskins Josiah Collier and DM Himmelblau. "Artificial Neural Network Models of Knowledge Representation in Chemical Engineering". *Computers and Chemical Engineering* 12.9-10 (1988): 881-890.