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Hyperspectral Pest Management by Map Reduce

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***Abstract* – Remote detecting is being utilized with Global Positioning Systems, Geographic Information Systems, and variable rate innovation to at last help ranchers augment the monetary and ecological advantages of product bug administration through accuracy agribusiness. Hyperspectral remote sensing has been used over a wide range of applications, such as agriculture, forestry, geology, ecological monitoring, atmospheric compositions and disaster monitoring. Airborne remote detecting is adaptable and flexible on the grounds that fields can be flown at variable height relying upon the spatial determination required. Hyperspectral remote detecting in extensive consistent thin wavebands gives noteworthy headway in comprehension the unobtrusive changes in biochemical and biophysical qualities of the product plants and their distinctive physiological procedures, which generally are unclear in multispectral remote detecting. Hyperspectral sensors are gadgets that secure pictures with thin groups (under 20nm) with nonstop estimation. It extricates otherworldly marks of articles or materials to be watched. Hyperspectral have more than 200 groups. Examinations were had to anticipate the effect of increment in temperature on number of eras of S. litura on nut in the place of Tirupathi(13° 2' N, 79° 2' E) in India for standard (1975-2015), introduce (2015-2039), not so distant future (2050-2069) and far off future (2080-2099) environmental change (A1B) situations. Higher aggregation of degree days making it conceivable maybe a couple extra eras of S. litura was derived for both close and inaccessible future environmental change situations contrasted with benchmark and present periods. On-homestead bug administration and product insurance firmly rely on upon finding of harvest ailment push in fields. In this paper, we first look at the materialness of broadband high-spatial-determination remote detecting information in noticeable and close infrared locales for shelled nut bug recognition and after that build up a way to deal with investigate their appropriateness.**

***Keywords* – Agriculture, Pest Management, Spodopteralitura, Spectrometer, Degree days, Map Reduce, Remote sensing, Hyperspectral.**

I. INTRODUCTION

Indian farming is the foundation of economy. Farming in India has experienced huge changes in the second 50% of the twentieth century. Utilization of substance manures and pesticides has assumed a positive part in expanding farming profitability and in making India independent in sustenance grain generation. A good IPM program has three components.

1. Identifying & monitoring pest problems
2. Select the best pest management tactics
3. Record keeping and evaluating the program.

The four fundamental gatherings of vermin are as per the following

a) Weeds – undesirable plants
b) Invertebrates – bugs, parasites, ticks, creepy crawlies, snails and slugs.
c) Disease specialists or pathogens – microscopic organisms, infections, parasites, nematodes my co plasmas and other miniaturized scale creatures.
d) Vertebrates – winged animals, creatures of land and water, fish, and rodents and different warm blooded creatures

Pest Management

Remote detecting loans itself astoundingly well to the identification of atypical areas inside a field or plantation that have been differentially influenced by weeds, sicknesses, or arthropod bugs (Hatfield and Pinter, 1993). Truth be told, over 35 years prior, ARS researchers were utilizing ethereal shading infrared photography for this reason and relating their discoveries to lab spectra of bug harmed leaves (Hart and Myers, 1968). Weeds speak to a substantial administration cost to producers since they rival crops for water, supplements, and light, regularly diminishing harvest yield and quality. Unseemly or inadequately planned herbicide applications can likewise have unintended symptoms on product execution and nature. In this manner, as of late there has been a move far from uniform, early season weed control choices towards approaches that depend on utilizing. Trim models give the capacity to reproduce distinctive administration alternatives under various climate conditions, while the remotely detected information permit the models to represent spatial fluctuation and give periodic "rude awakenings." As these techniques develop, it will turn out to be progressively imperative to join display yield with multi target choice emotionally supportive networks that likewise consider components, for example, monetary, work, and time requirements (Jones and Barnes, 2000). Choice emotionally supportive networks will likewise be expected to deal with lot of remotely detected and other information contained in a GIS (Doraiswamy et al., 2000). Proficient administration of supplements is one of the primary difficulties confronting creation horticulture. Here, remote detecting is giving field-scale demonstrative techniques that will empower recognition of supplement insufficiencies sufficiently early to dodge yield or quality misfortunes. At the point when interfaced with variable rate sprayer hardware, constant covering sensors could supply site particular application prerequisites that

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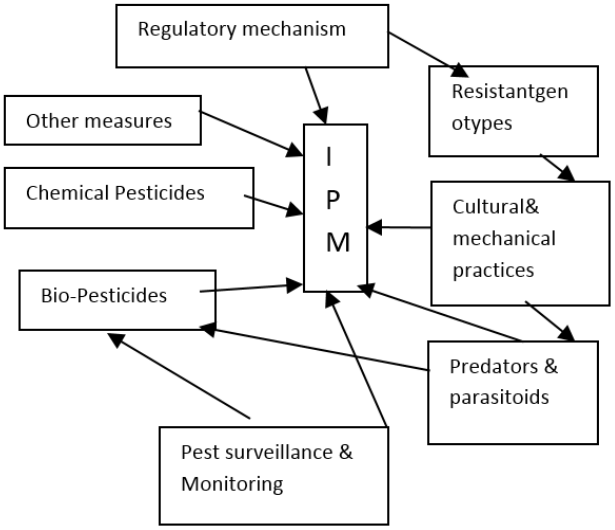
diminish pollution of surface-or groundwater supplies and enhance general supplement utilize effectiveness (Schepers and Francis, 1998).

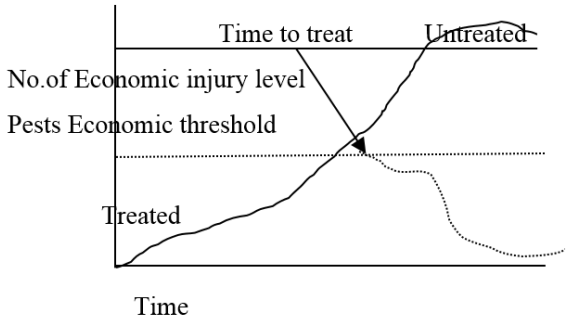


Diagrammatic Representation of IPM components

The above diagram represents the all IPM components that are Regulatory mechanism, Resistant genotypes, Cultural & mechanical practices, Predators & parasitoids, Pest surveillance & Monitoring, Bio-Pesticides, Chemical Pesticides and Other measures.

Peanut (Arachishypogaea L.) otherwise called groundnut, earthnut and ground bean, is the world's fourth most imperative wellspring of consumable vegetable oil and third most vital wellspring of vegetable protein. Generation is moved in Asia (half of worldwide territory and 64% of worldwide creation) and Africa (46% of worldwide range and 28% of worldwide creation), where the yield is become for the most part by smallholder agriculturists under rainfed conditions with constrained data sources. China, India, Nigeria, USA and Myanmar are the real shelled nut developing nations. India is the second biggest maker of shelled nut on the planet with a normal yearly creation of 5.51 million tons (http://faostat.fao.org) from a territory of 5.47 million ha. Efficiency levels of shelled nut in India is1007 kg/ha as against 1522 kg/ha of the globe and 3356 kg/ha of China. Lifted CO2 was accounted for to bring about critical increment in all out biomass at conclusive reap of shelled nut edit yet diminished last seed yield in chose cultivars (Bannayan et al. 2009). The harvest is assaulted by numerous types of creepy crawlies which cause harm extending from coincidental encouraging to close aggregate plant annihilation and yield misfortune (Wightman and Ranga Rao 1994). Amongst them, Spodopteralitura (Fab.) is a noteworthy irritation which can bring about yield misfortunes of 35-55%. Hatchlings encourage gregariously on leaves bringing about serious defoliation, leaving just midrib veins. The life cycle of S.litura as appeared on left The eggs of the bunch caterpillar (Spodopteralitura [Fabricius]) (Lepi-doptera: Noctuidae) are laid in groups of 200 to 300 underneath leaves and secured with cocoa scales from the body of the mother. They incubate in three to five days. The hatchlings nourish in a gathering when they are youthful yet spread out as they get more established. When they are mature they leave the plants and pupate in a small cell in the soil. The life cycle takes about 30 days. The adult moths are nocturnal and are not often seen. The larvae are primarily leaf feeders but may occasionally cut young plants at the soil line.

The use pattern of pesticides reflects that peanut crop alone consumes 44.5% pesticides, which accounts for 22.8% of pesticide consumption. Thecrop consumes more than two thirds of the total quantity of the pesticides used in the country. Creating enhanced systems for administration of bugs requires a superior comprehension of atmosphere vermin connections and henceforth information on atmosphere and creepy crawly bugs is an essential. Atmosphere assumes a noteworthy part in the development, advancement and dissemination of creepy crawlies. The fleeting change in climate conditions at an area is named as atmosphere fluctuation and the long haul change in normal atmosphere of the area is alluded to as environmental change and both impact the development and advancement of creepy crawlies. Current assessments of atmosphere changes demonstrate an expansion in worldwide. In the below figure represents time based number of pests threshold.



II. LITERATURE SURVEY

Insect pests by analysis the relationship between geographic conditions, climate resources and occurrence of insect pests (Schell *et al.,* 1997). So the GIS could be employed to predict effect of climatic changes on insect, that effect on geographical distribution, Behavior and physiology of insects (Parmesan 2007 and Merrill *et al.* 2008). Temperature has a direct influence on insect activity and rate of development (Zalom and Wilson, 1982). The assessment report from the Intergovernmental Panel on Climate Change (IPCC) predicts an increment in mean temperature from 1.1 to 5.4o C toward the year 2100 (Meehl*et al.* 2007). The thermal unit provides a valuable tool for insect pest control; in forecasting infestations monitoring and timing of insecticide applications (Zalom*et al.*, 1983). Moreover estimation of generations number of insects relying on current and expected future climatic factors such as maximum, minimum and mean temperature (Abolmaaty *et al.,* 2010). In addition, such changes in climatic conditions could profoundly affect the population dynamics and the status of insect pests of crops (Woiwod, 1997). Development of aphid is faster in warmer temperature (Kuo, *et al.*, 2006; Park and Obrycki, 2004; Razmjou and Golizadeh, 2010; Sharma and Bhatnagar, 2002).

III. PRINCIPLES OF INTEGRATED PEST MANAGEMENT

Eight standards of Integrated Pest Management that fit inside maintainable ranch administration. Here, we propose to agriculturists, counsels, and specialists a dynamic and adaptable approach that records for the differing qualities of cultivating circumstances and the complexities of agro biological communities and that can enhance the versatility of trimming frameworks and our ability to adjust edit insurance to neighborhood substances.1.Prevention and Suppression, 2. Monitoring, 3. Decision Making, 4.Non-Chemical methods, 5.Pesticide Selection, 6.Reduced Pesticide Use, 7.Anti-Resistance Strategies and 8.Evaluation

Materials and Methods

The work includes three segments viz; 1.obtaining verifiable information and atmosphere projections on day by day temperature from individual network point. 2. Calculation of developing degree days (GDD) for fruition of life of S.litura base on the limit temperature and 3. Estimation of the conceivable number of eras amid the yield season later on anticipated atmosphere by substituting the temperature utilizing SRES A1B situation.

Statistical Analysis

Mean number of generations were compared using two-sample-test assuming equal variances. The recent report of the Inter governmental panel on climate change (IPCC) and collect the s.litura on peanut database on tirupathi from peanut during future climate change scenario. The variation in the number of generations and generation time was decomposed by subjecting the data to ANOVA to understand the contribution of location, model, scenario and period to the total variation (Srinivasa Rao et al., 2012). The sum of squares attributable to each source was divided by the total sum of squares explained by the model to obtain the individual contribution of each source. All statistical analyses were done using SPSS version 16.0.3

Estimation of number of generations of S. litura on Peanut

Growing Degree Days (GDD) approach is used to predict the life cycle of insects in the form of number of generations during the season by measuring the growth in terms of temperature over time considering average daily temperatures which influence insect development. Expected number of generations were estimated using 'INGEN', wherein accumulated thermal degree days were calculated by horizontal cut-off (degree-day accumulations above the upper threshold do not count) method. The software provides data on GT (Generation Time) in days as given above, mean GDD (Mean Growing Degree Days—accumulated degree days to complete one generation after reaching cut-off GDD) and Total Degree Days (TDD—total summation of the degree days in a calendar year or crop season).The standard GDD approach was followed to estimate the number of generations of S. litura occurring on peanut during a crop season. The maximum and minimum temperatures were transformed to heat units using the lower threshold temperature (t0) of 10°C for S. litura on peanut and the standard method for estimation of the degree days (thermal requirements) of reach day was calculated by using the formula.

$$H = \Sigma D - D$$ Where:

H = Number of heat unit to emergence

$D - D = (T.max + T.min)/2 - t_0$

t_0 = threshold temperature = $10°C$

Information organizer

- The information records ought to be put away in "Information" organizer.
- Separate documents of day by day TMAX and TMIN are to be made and put in the DATA organizer.
- The documents must be comma isolated qualities with an augmentation of .csv

- The information record ought to be made precisely in the endorsed organize.
- No other arrangement of information document is satisfactory or perfect.
- Average temperature and warm warmth units in light of edge given will be computed naturally.
- The information documents ought to contain an ampersand (and) toward the end of the record. The information after ampersand (&) will be disregarded.

The yield contains the accompanying tables

1. Degree Days: Annual 5. Degree Days: (crop duration) e.g. 176 - 308 days
2. Total Degree Days: Annual 6. Combined Degree Days: (trim span) e.g. 176 - 308 days
3. Rundown of Cumulative Degree Days: Annual 7. Outline of Cumulative Degree Days : (crop duration) e.g. 176 - 308 days
4. Eras: Annual 8. Eras: (crop duration) e.g. 176 - 308 days

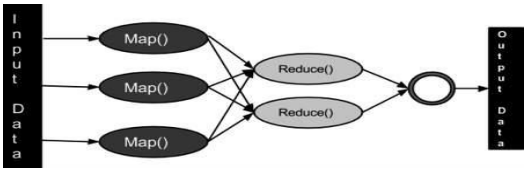
Case : Where 176 and 308 are product season beginning and consummation days separately.

Hadoop

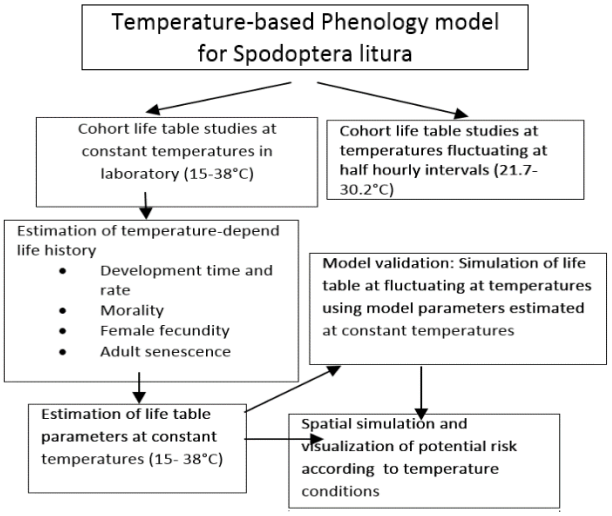
Hadoop is an open-source extend regulated by the Apache Software Foundation. Hadoop's patrons work for a portion of the world's greatest innovation organizations. That differing, inspired group has created a shared stage for solidifying, joining and comprehension information. In fact, Hadoop comprises of two key administrations: information stockpiling utilizing the Hadoop Distributed File System (HDFS) and expansive scale parallel information handling utilizing a strategy called Map Reduce. Hadoop Distributed File System (HDFS), permits client information to be sorted out as records and registries. It gives an order line interface called FS shell that gives a client a chance to communicate with the information in HDFS open to Hadoop Map Reduce programs. There are two methods to interact with HDFS:1. You can use the command-line approach and invoke the File System (fs) shell using the format: hadoopfs <args>. This is the method we will use in this lab..2. You can also manipulate HDFS using the Big Insights Web Console.

Map Reduce

Map Reduce is a structure utilizing which we can compose applications to prepare immense measures of information, in parallel, on vast bunches of item equipment in a solid way. The real favorable position of Map Reduce is that it is anything but difficult to scale information handling over numerous figuring hubs. Under the Map Reduce display, the information preparing primitives are called mappers and reducers. Deteriorating an information handling application into mappers and reducers is in some cases nontrivial. Yet, once we compose an application in the Map Reduce shape, scaling the application to keep running over hundreds, thousands, or even a huge number of machines in a bunch is only a design change. This basic versatility is the thing that has pulled in numerous software engineers to utilize the Map Reduce display.



Production of more number of generations annually with extreme temperatures in case of majority of insect species is well known and this phenomenon becomes regular with gradual warming (Lastuvka 2009) and our results add *S. litura* on peanut in India to the list as a case in point.



Inputs and Outputs (Java Perspective)

The Map Reduce framework operates on <key, value> pairs, that is, the framework views the input to the job as a set of <key, value> pairs and produces a set of <key, value> pairs as the output of the job, conceivably of different types. The key and the value classes should be in serialized manner by the framework and hence, need to implement the Writable interface. Additionally, the key classes have to implement the Writable-Comparable interface to facilitate sorting by the framework. Input and Output types of a Map Reduce job: (Input) <k1, v1> -> map -><k2, v2>-> reduce ><k3,v3>(Output).

	Input	Output
Map	<k1, v1>	list (<k2, v2>)
Reduce	<k2, list(v2)>	list (<k3, v3>)

IV. EXPERIMENTAL RESULTS

The National Land use/Land cover classification developed by National Remote Sensing Centre (NRSC) and Indian Space Research Organisation (ISRO) divides the land in the study area into five Level I classes, 11 Level II classes, and fifteen Level III classes. From this three-level hierarchic based classification, it was found

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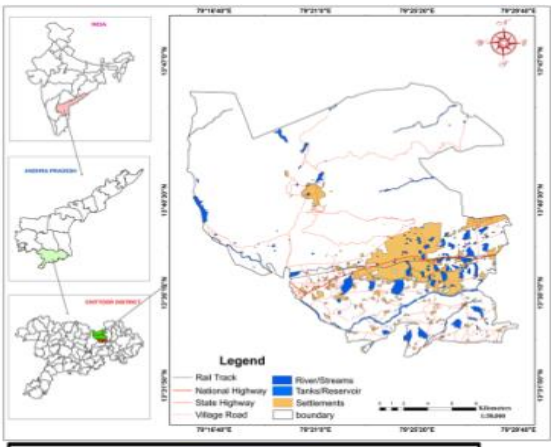
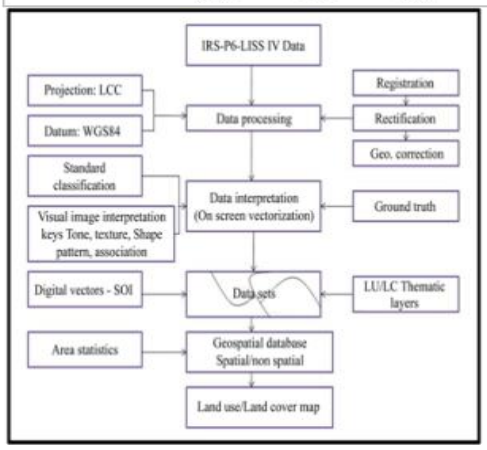
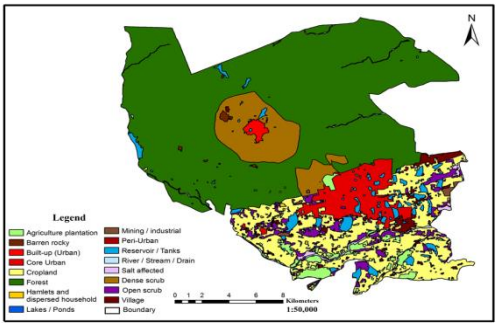
that the Forest is the major LULC category in the Tirupati area covering 227.46 km^2 (58.55%), followed by Agricultural land, Wastelands, Built-up land and water bodies contributing to 70.36 km^2 (18.11%), 43.92 km^2 (11.31%), 32.71 km^2 (8.42%) and 14.03 km^2 (3.61%) respectively of the total geographical area. However, interactions between climate change, crops and pests are complex, and the extent to which crop pests and pathogens have altered their latitudinal ranges in response to global warming is largely unknown. The present study features the estimation of number of generations of Spodopteralitura. Fab. on peanut crop at tirupathi in India using MarkSim, which provides General Circulation Model (GCM) of future data on daily maximum (T.max), minimum(T.min) air temperatures. Geographical location explained 34% of the total variation in number of generations, followed by time period (26%), model (1.74%) and scenario (0.74%). The remaining 14% of the variation was explained by interactions. Increased number of generations and reduction of generation time across the peanut growing locations of India suggest that the incidence of S. litura may increase due to projected increase in temperatures in future climate change periods. In this case the pheromone trap 'first catch 'was considered as a Biofix and the cumulative degree days for *S. litura* was estimated for the crop season covering 133 days of crop duration across tirupathi location.







Example Scenario

Given below is the data regarding the electrical consumption of an organization. It contains the monthly electrical consumption and the annual average for various years.

If the above data is given as input, we have to write applications to process it and produce results such as finding the year of maximum usage, year of minimum usage, and so on. This is a walkover for the programmers with finite number of records. They will simply write the logic to produce the required output, and pass the data to the application written. But, think of the data representing the electrical consumption of all the large scale industries of a particular state, since its formation.

TIRUPATHI_MIROC_TIR_YEAR_1975_MIROC_TIRUPATHI_1975_13 - 79_GROUNDNUT_S.LITURA
Degree Days :
Annual

Day	1975	1976	1977	1978	1979	1980	1981	1982
1	9.65	11.15	16.45	16.05	10.6	13.75	11.85	12.85
2	11.5	8.6	15.3	13.7	12.65	10.2	12.35	16.9
3	10.5	11.25	13.05	13.35	14.6	10.85	13.1	12.4
4	9.6	8.85	15	11	11.95	8.45	12.7	10.4

In weka we are using 6 clustering algorithms i.e Expectation Maximization (EM) Clustering, Farthest First Clustering (FFC), Hierarchical Clustering (HC), Make Density Based Clustering (MDBC), K-means and Filtered Clustering(FC) on tirupathi_miroc_tir_year_ 1975_miroc_tirupathi_1975_13 - 79_groundnut_s.litura dataset. The present study features the estimation of number of generations of Spodopteralitura. Fab.on peanut crop at tirupathi in India using MarkSim, which provides General Circulation Model (GCM) of future data on daily maximum (T.max), minimum(T.min) air temperature of MIROC3.2 along with an ensemble of three emission scenarios (A2, A1B and B1). The daily data during the crop duration of 133 days from 26th to 44th standard weeks were considered for predicting the number of generations and generation time of S-litura. Table 1.1 shows the accuracy results of all methods use the training set of S-litura and Figure 1.1: shows the Comparison based on cluster instances total value, percentage and time on all clustering Algorithms

		EM		HC		FFC		MDBC		K-means		FC	
Clustered Instances	0	15	11%	121	91%	93	70%	76	57%	76	57%	76	57%
	1	24	18%	12	9%	40	30%	57	43%	57	43%	57	43%
	2	35	26%	-	-	-	-	-	-	-	-	-	-
	3	20	15%	-	-	-	-	-	-	-	-	-	-
	4	15	11%	-	-	-	-	-	-	-	-	-	-
	5	9	7%	-	-	-	-	-	-	-	-	-	-
	6	15	11%	-	-	-	-	-	-	-	-	-	-
Total		133	99%	133	100%	133	100%	133	100%	133	100%	133	100%
Time taken to build in seconds		31.97		0.09		0.03		0.03		0.03		0.03	

Table 1.1: Accuracy results of all methods in training set of S-litura pest on groundnut

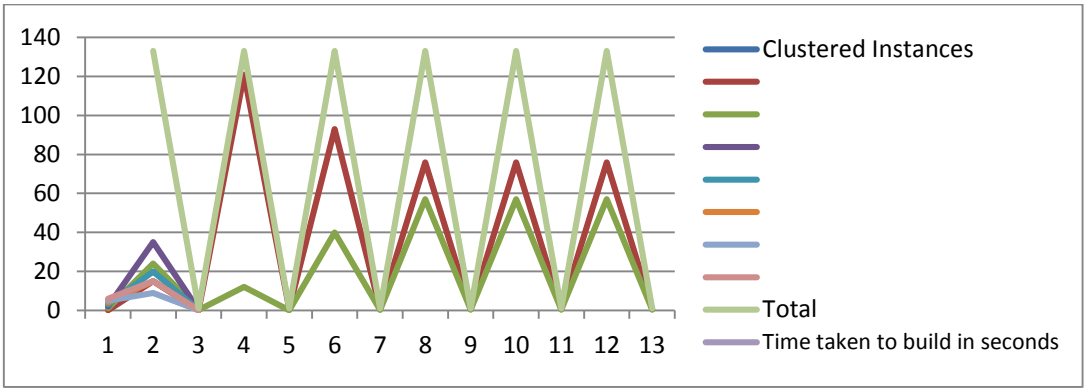


Figure 1.4: **Comparison based on cluster instances total value, percentage and time on all clustering Algorithms**

Now that we've seen how the File System (fs) shell can be used to execute Hadoop commands to interact with HDFS, the same *fs* shell can be used to launch Map Reduce jobs. In this paper, we will walk through the steps required to run a Map Reduce program. The source code for a Map Reduce program is contained in a compiled .jar file. Hadoop will load the JAR into HDFS and distribute it to the data nodes, where the individual tasks of the Map Reduce job will be executed. Hadoop ships with some example Map Reduce programs to run.

Pseudo code for Map Reduce

```
void Map (key, value){
        for each word x in value:
              output.collect(x, 1);
void Reduce (keyword, <list of value>){
        for each x in <list of value>:
              sum+=x;
        final_output.collect(keyword, sum);

map(String key, String value)
// key: document name
// value: document contents
 for each word w in value
   EmitIntermediate(w, "1")

reduce(String key, Iterator values):
// key: word
// values: a list of counts
  for each v in values:
    result += ParseInt(v);
Emit(AsString(result));
```

V. CONCLUSION

We have examined about hyperspectral imaging foundation, imaging frameworks, applications in accuracy agribusiness and procedures to handle hyperspectral information. By using weka tool of data mining on s.litura pest data total instances of 133 and 105 attributes on 6 clustering algorithms FFC is the best for all other clustering techniques. In EM 6 cluster instances taken but 99% of accuracy and time taken to build 31.97 seconds. In HC, MDBC 100% accuracy but time 0.09 in HC and 0.05 in MDBC. Cluster instances of FC, K-means, MDBC, FFC and HC are same but the time is varying FFC, FC get 0.03 time taken to build. FC generates number of iterations 5 and within cluster sum of squared error occurred that's way FFC is the best for all other clustering techniques on S-litura pest data on groundnut. Hyperspectral imaging frameworks empowers specialists to get data required to perform exactness horticulture hones. The general exactness of hyperspectrural symbolism is superior to the multispectral picture handling particularly in nuisance administration. However the information the intricacy and space multifaceted nature for the Hyperspectral picture

handling is more. Utilizing hyperspectral symbolism and GIS arrive administration framework the accuracy agribusiness could be actualized in creating nations. As the populace is expanding and assets, for example, water and farming area is being constrained, hyperspectral accuracy horticulture turns into an imperative research territory for the future improvement. This paper will serve as a beginning stage for experts in both farming bug administration and picture handling to comprehend utilization of hyperspectral picture preparing in agribusiness.

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